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THE PHYSICAL GROWTH OF CHILDREN FROM BIRTH TO MATURITY

BY

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PART I

CHAPTER I

INTRODUCTION

How do children grow physically? This *Study*, which aims to aid in the answer of this question, presents data and results of direct value in the formulation of standard norms in physical growth, with a view to establishing a basic science for allied investigations in mental, educational, social and moral development and clinical studies in nutrition.

In the foreword of the writer's previous *Monograph* in 1914 (27) it was stated:

> "The chief value of the *monograph* consists in the fact that it is the first attempt to follow consecutively the same groups of children through the elementary and high schools, either in physical growth or school standing, or the relation of the two. Since the curves and records represent individual histories, they will be of permanent value. The monograph also aims to give the present status of the problem of physical growth."

Since 1914 no similar reports in individual growth have appeared. This *Study*, which is limited to an intensive analysis of the problem of physical growth, is a sequel to the former *monograph* without in any sense being a duplication of material. The entire field of growth from birth to maturity is treated from the ontogenetic standpoint, with the coördinate subjects of anatomical and physiological ages. In the first eight chapters, or *Parts I-IV*, the context, tables, charts, and photographs are published here for the first time. The charts are based upon the writer's data. The Historical Orientation, the Comparative Tables and the Bibliography, *Parts IV-VI*, are completely reorganized elaborations of similar sections of the earlier publication, brought up to date.

Part I of this *Study* states the problem under consideration, discusses anthropometric instruments and methods, and outlines the anthropometric service of the Child Welfare Research Station, with some results from 5772 Iowa children. *Part II* gives as original data 5000 weight measurements on 400 infants; the height and weight of 9074 infants with comparative curves from

other investigations; the height and weight of 27,912 pre-schoo children; also 400 individual growth curves and 1548 total o partial coefficients of correlation. *Part III* presents an analysi of original data in the anatomical and physiological ages fron 6500 boys and girls. *Part IV* includes an historical survey, i classified and chronological order, of 911 investigations in physica growth in this country and abroad. *Part V* summarizes in 64 comparative tables of measurements on infants, pre-school childrer school children and adults under 30 years of age, data from al available authorities, comprising approximately 5,385,400 recorde cases in various countries. *Part VI* is an annotated bibliograph in alphabetical order, of the 911 titles on the problem of the growtl of infants, children and adults. *Part VII* furnishes in the forn of a *Supplement* the English equivalents for the metric units o measurements, since all data, tables and charts in this *Study* ar in the French system. A practical score card is also given in th English units of measure. The summaries, or conclusions, of th *Study* will be found at the end of each section or chapter, arrange in paragraph form. Supplementary data for the conclusions for *Part III* may be found in the original monograph (27) It has not been considered necessary to repeat the conclusions of the various chapters at the end of the book, since these conclusions can be much more conveniently and intelligently considered in connection with the data upon which they are based. In some instances the accumulated conclusions substantiate the same basic principles of growth from different points of view, but in no case is there direct duplication of the same conclusions. All conclusions are based on the writer's data.

The present task of collecting and interpreting original data and summarizing and evaluating other investigations, has been a long and exacting one, but the results will be worth the effort if other investigators are attracted to the field and former interested scientists will continue to make more intensive studies. *The results should form an international basis for scientific work in child development and welfare.* The writer's early interests in physical growth arose out of experimental work in child and educational psychology,—a field in which similar *Studies in Mental Growth* are being prepared for later publication.

The names of the interested persons who have assisted in securing data for the *Study* will be found distributed throughout the

context. The many good friends who have used or criticized the previous monograph have added much to the value of this *Study*. In particular Dr. Alês Hrdlička, curator of the Smithsonian Institution in Washington, D. C., helped directly in securing the anthropometric instruments and assisted in determining the methods and technique described in Chapter III. Dr. John Howland, chief of the Department of Pediatrics of the Johns Hopkins Hospital, made accessible to the writer the data used in Chapter IV and read the typewritten copy of this chapter of the manuscript on the Weight of Infants. Professor Karl Pearson, Director of the Francis Galton Laboratory in London read the chapter on correlations (VI), and made some significant suggestions, especially in regard to the desirability of including the coefficients of variation. Dr. Bundy Allen, Head of the Department of Roentgenology of the Medical College of the University, coöperated directly in taking the X-ray photographs used in Chapter VII.

The writer also has an added pleasure in acknowledging the valuable assistance and suggestions of Dr. Lorle I. Stecher, Research Associate in the Station who has contributed materially to Sections IV, V and VI, and who has read critically the manuscript and proof.

The names of the various schools which have furnished data will be found in the context of the *Study*. In addition to the University of Iowa Observational Schools and public schools in the state, special acknowledgement is made to Horace Mann School, Teachers College, Columbia University; University of Chicago Elementary and High Schools; Francis W. Parker School of Chicago; Baltimore Friends' School; and Friends' Select School, Washington, D. C.

CHAPTER II

ANTHROPOMETRIC INSTRUMENTS AND METHODS OF MEASURING

The international standardization of instruments and methods for taking measurements on living subjects is of paramount importance in the securing of comparable data for the science of physical growth. The Iowa Child Welfare Research Station has established through coöperation and collaboration with other scientific organizations and laboratories, standard instruments, accurate technique and uniformity of anthropometric methods within the fields limited to child development. Since the establishment of the Station there has been close coöperation with some of the leading anthropometrists in America, especially with the division of anthropology of the National Research Council, and the United States National Museum of the Smithsonian Institution, Washington, D. C. Dr. A. Hrdlička spent one week at the Station assisting in formulating methods of procedure for the anthropometric work. It has been through his coöperation that the compasses and calipers have been obtained. The other instruments have been made in the University shops, under the writer's direction. The aim has been to secure:

(1) Instruments with accurate units of measure in the metric system.

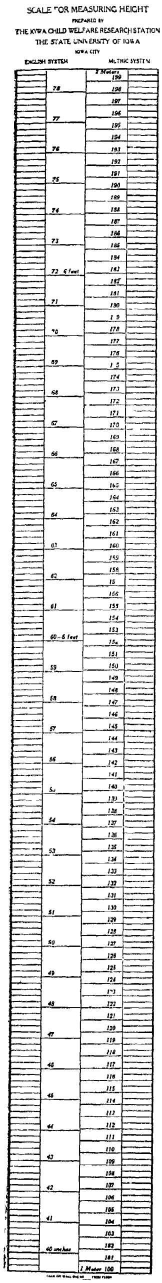
(2) Light, convenient, portable instruments of non-expandable material and simple design.

(3) Uniformity in standards of technique for measuring.

(4) The acceptance of definite land-marks for determining measurements.

1. Instruments

a. *The Paper Measuring Scale* (Photograph 1) This type of plane, which is a modification of the plane of Broca, was originally suggested by the Committee on Anthropology of the National Research Council; it has been modified by the writer and printed by a local printer. The plane consists of a strip of the best type



Photograph 1.

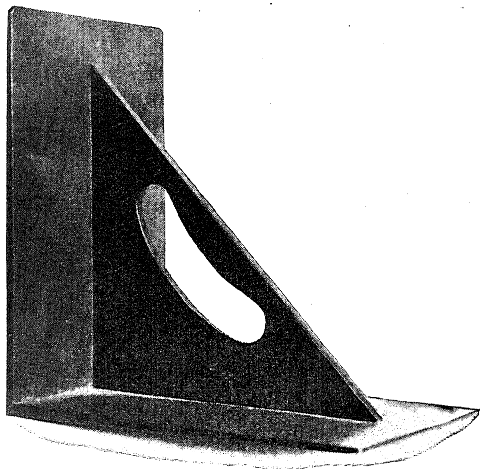
of inextensible and unshrinkable paper, one meter long and twelve and a half centimeters broad, with the metric divisions on the right edge of the scale in centimeters and millimeters, and the English on the left edge in feet, inches and fifths of an inch, and with a margin on each side of the scale and also at the top and bottom. An attempt was made to have a plate made from the scale as drawn by a draftsman, but this plan was abandoned, and the printed scale was substituted. Since the slugs used in printing are a little less than .5 mm. in thickness and the width of the line introduces a constant error, it was necessary to use strips of thin tissue paper between the separate slugs and to measure each millimeter distance accurately as a unit.

The paper plane has been used for several months and there has been no appreciable shrinkage under usual weather conditions. The chief advantages of the scale are that it is portable, may be sent through the mail, and is easily tacked or pasted to a wall or a specially prepared board. The position can be standardized, which is not possible with a rod.

The five millimeter unit has been used in place of the one millimeter, as the examiner soon becomes able to estimate the millimeters accurately, the reading is less fatiguing to the eyes and there is an added interest in the estimation of each particular case for measurement. The paper plane in the vertical position is used in measuring standing height and height sitting and in the horizontal position for the span of arms.

b. *The Square* (Photograph 2) The square consists of two pieces of seasoned walnut 18 cm. by 13 cm., joined at right angles. On the inside of the median line is a narrow strip 5 mm. thick, in which is cut an opening that serves as a handle. The square which is used for the three measurements just stated above was constructed in the University Shops.

c. *The Bench.* The bench, also constructed in the University Shops, is used for height sitting. It is made of thoroughly seasoned walnut. Two sizes have been adopted, one 30 cm. in height by 30



Photograph 2. Square

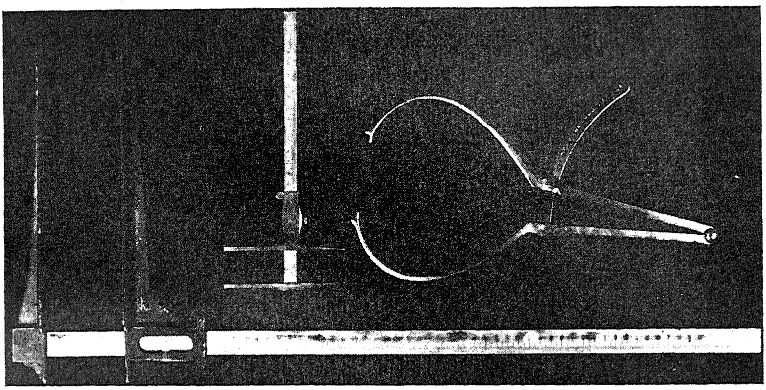
cm. square, the other 40 cm. in height by 40 cm. square. For adults, it is recommended that a third size, 50 cm. square be used.

d. *Large Sliding Calipers* (Photograph 3) The large sliding caliper is the Hrdlička compass made in Washington for the Research Station and tested by the Bureau of Standards. This compass has also been made by Collin in Paris. The caliper consists of a hollow rod, 70 cm. long, 2.2 cm. broad and 0.8 cm. thick, made of well nickeled and welded brass strips; and of aluminum branches, 26 cm. long (in the free) and 3.5 cm. broad. It is light, very serviceable, durable, easy-working, and accurate.

e. *Small Sliding Calipers* (Photograph 3) The sliding caliper (compas glissière) was made in Washington and tested by the Bureau of Standards. This is the Collin compass and is accurately and well designed.

f. *Spreading Calipers* (Photograph 3) The calipers in use are the Hrdlička type, made by Dr. Ballauf, Washington, first made by Collin in 1912. The terminal parts are in a straight line at the spread of 10 cm. There is a guard on the lower portion of each branch 8 mm. from the point, to regulate the distance of introduction into the meatus. The resulting instrument is but imperceptibly

heavier than the older standard compass of Mathieu; it serves with equal facility the same purposes.



Photograph 3. Three Types of Calipers

g. *Tapes.* On account of the delay in receiving linen tapes from Paris, the ordinary millimeter steel tape is used. It has several disadvantages, a linen tape of non-elastic material being preferable.

h. *Scales.* The scale in use in the anthropometric laboratory is the Buffalo type with pillar 3′ 3″ high, on wheels, beam being triple bar. On one side:

Top bar is marked 100 (50 kilo graduation)
Middle bar is marked 50 (5 kilo graduation)
Lower bar is marked 5 (1/20 kilo graduation)

On other side:

Top bar is marked 200 (100 pound graduation)
Middle bar is marked 100 (10 pound graduation)
Lower bar is marked 10 (1/10 pound graduation)

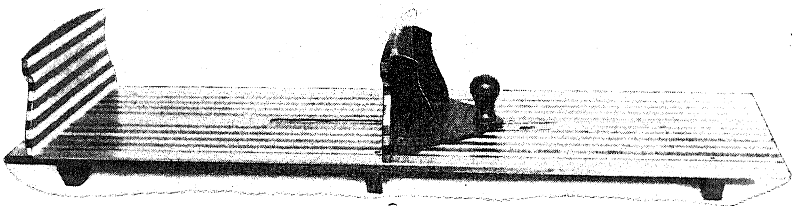
This scale is accurate, portable from room to room but heavy for transportation.

i. *Dynamometer.* So far the Smedley hand dynamometer sold by Stoelting has been used, but the Collin instrument will be substituted as soon as it is received from abroad. The "Martin Method" which uses the spring balance scales is also being tested out.

j. *Wet Spirometer.* No spring spirometer has been found to be accurate. The Stoelting model is used. This apparatus is too familiar to warrant description here.

k. *Measuring Board for Infants* (Photograph 4). The accom-

panying photograph shows a new measuring scale for determining the reclining length and reclining sitting height of infants. It was designed by the writer and made in the manual training shop of the University. The scale is one meter in length, with an additional margin of 4.5 centimeters at the one end. The width is 20.5 centimeters, with standardized buttonwood millimeter scales on either side. The vertical plane for the head rest is 15 centimeters at its greatest height, and the sliding vertical plane is attached to a brass rod which moves freely in a brass groove in such a manner that the millimeter reading may be taken from either side. The



Photograph 4. Measuring Board for Infants

board is made of inlaid walnut and buttonwood and the standards on which it rests when in contact with the table, are covered with heavy felt. The scale is accurate and portable.

2. Measurements Taken

For purposes of determining the physical development of children from birth to maturity the following list of measurements has been selected for use in the anthropometric department of the Research Laboratory.

A. LENGTH.

1. *Standing*
2. *Sitting*
3. *Span of arms*
4. *Upper arms (shoulder-elbow)*
5. *Forearm (elbow-finger tip)*
6. *Lower leg*
7. *Face*

B. WIDTH.

8. *Shoulder*
9. *Hips*

10. *Face*

C. DIAMETER.

11. *Head (anterior-posterior)*
12. *Head (transverse)*
13. *Head (height)*
14. *Chest (width)*
15. *Chest (depth)*

D. CIRCUMFERENCE

16. *Head*
17. *Chest*

E. WEIGHT

18. *Body weight*

F. BREATHING CAPACITY

19. *Lung capacity minus residual air*

G. STRENGTH

20. *Strength of right forearm*
21. *Strength of left forearm*
22. *Strength of wrist-right and left*
23. *Strength of elbow-right and left*

H. INDICES

24. *Sitting-standing*
25. *Cephalic-index*
26. *Chest-index*
27. *Vital-index*
28. *Weight-index*

I. CRANIAL CAPACITY

3. Methods

A. LENGTH

(1) *Standing Height.* This measurement is made with the *Research Station Paper Measuring Scale* previously described, and the wooden *square.* The subject stands straight with heels together, and heels, buttock, upper part of back (and generally the head) against the wall to which the scale is attached. The arms are extended at the side in a natural position and the head is in such a position that the visual and biauricular axes are horizontal. The *square* may be held in either hand. If held in the left hand the readings are taken from the right margin of the plane and if held in the right hand, from the left margin of the plane. The *square* is

Photograph 5. Method of Measuring Standing Height

brought down firmly two or three times in succession on the top of the head, with sufficient force to feel the impact of the skull, and the reading taken from the last position.

(2) *Sitting Height.* For the measurements of the sitting height, the Geneva agreement has been followed which recommends: "The subject sits on a horizontal and resisting seat (bench) about 30 to 40 cm. high (this height being proportionate to the stature of the subject): the knees are flexed; the dorsal aspect of the trunk is to make contact with the vertical plane or with the anthropometric rod or plane at two points viz., at the sacral region and again between or at the shoulder blades. The axis of vision is horizontal. The height of the vertex above the surface of the seat is to be measured." (406 p. 64.)

(3) *Span of Arms.* This measurement is the distance from the tip of the middle finger (medius) of the left hand to the tip of the middle finger (medius) of the right hand with maximum extension of the arms when the subject is standing in a normal position, similar to the position required for stand-

ing height, against a plane background. The child's left middle finger touches a vertical wall or moulding and the right extends over the *paper plane* placed in a horizontal position at a level with the child's shoulders with the fingers rigid. The two arms are extended and after the right arm (free arm) has been raised in a line with the left the observer applies the *square* lightly against the

Photograph 6. Method of Measuring Length of Forearm

free end of the middle finger of left hand and reads the greatest distance recorded, noting that both fingers are simultaneously in contact with the terminal limits.

(4) *Upper Arms.* The *large sliding calipers* are used. The

elbow is flexed and the terminal points are the acromion at the shoulder and the external condyle of the humerus at the elbow.

(5) *Forearms.* The *large sliding calipers* are used to find the distance from the olecranon process of the elbow to the finger tip, with the elbow flexed at right angles in front of the subject and with palmar side up. This measurement varies with the two arms and the position of the arm. It is being standardized by Mr. Howard R. Mayberry of the Station. (Photograph 6)

(6) *Lower Leg.* This measurement is from the knee to the sole of the foot when the knee is flexed at right angles. The measurement is made with the *large sliding calipers.*

(7) *Face.* The length of the face is taken with the *spreading calipers* from the nasion (the mid-point of the naso-frontal suture) to the lowest point of the chin.

B. WIDTH

(8) *Shoulders.* The *large sliding calipers* are used for finding the distance between the two great prominent tuberosities of the humerus bones below the acromion processes. The arms hang down at the subject's side and the pressure of the calipers is increased until the resistance of the bone is appreciably felt.

(9) *Hips.* The width of hips is measured in a similar manner to that of the shoulders with the *large sliding calipers,* using the widest part over the trochanters for the two terminal points.

(10) *Face.* The width of the face is taken with the *spreading calipers* at the greatest bizygomatic distance.

C. DIAMETER

The methods adopted here are those of Hrdlička (406)

(11) *Head* (*anterior-posterior*)

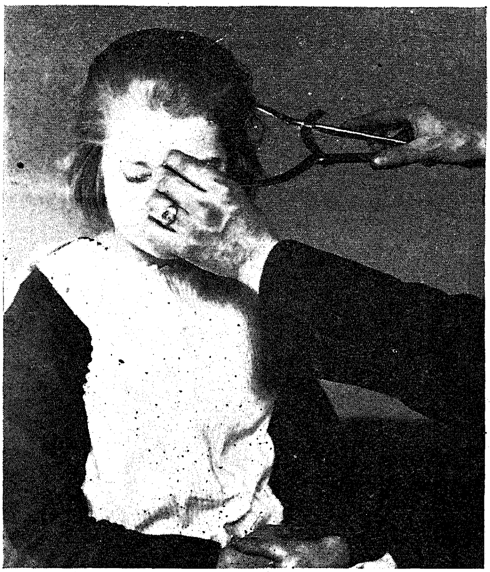
"The maximum glabello-occipital diameter of the vault."

Instrument: The spreading compass or calipers (compas d'êpaisseur, Broca or Hrdlička).

"Landmarks: Anteriorly—the most prominent point of the glabella; posteriorly—the most prominent point of the occiput as shown by the maximum determinable spread of the branches of the compass (Intern. Agr.)

"Method: According to older methods (see Bertillon, Martin), the end part of each branch of the instrument was held in one hand, as in measuring the face. For measurement of the head this is somewhat clumsy. A better method is to hold the compass so that its butt (or joint) rests on the hypothenar eminence of the hand, the two proximal parts of the branches reposing respectively on the ball of the medius and on the second joint of the forefinger, while the thumb holds the instrument to the

hand. The observer applies the thumb and middle finger of his left hand, in contact, to just below the glabella, places the free end of the left branch of the compass on these fingers so that the point touches the glabella, and applies the left forefinger over the end. This gives a ball-and-socket arrangement which enables the measurer to hold the point of the left branch of his compass steadily over the glabella without fear of displacement. This branch of the instrument needs no further attention. The right hand is now moved around the proximal part of the compass, so that the two branches rest on the ball of the fourth and on the second joint of the middle finger and are held and controlled by the ball of the thumb and the ball of the forefinger. This hold permits not only an easy handling of the instrument with perfect control, but affords also a great



Photograph 7. Method of Measuring Length of Head

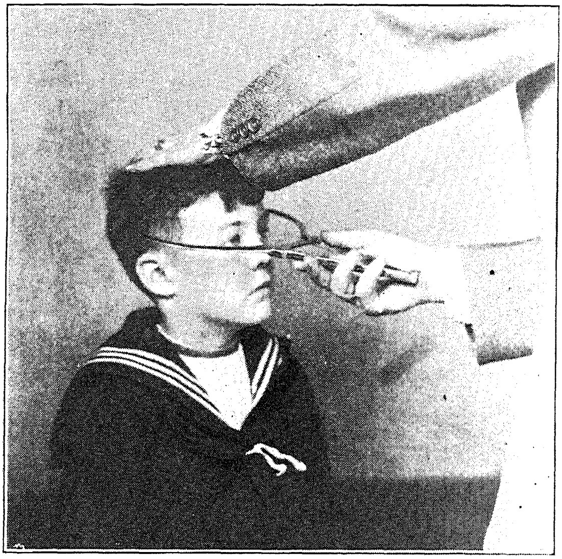
facility for regulating the pressure. The free end of the right branch is then applied over and somewhat to one side of the median line of the most prominent part of the occiput, and is moved up and down in saw-tooth fashion from side to side of the occiput until the maximum length is encountered. The eyes watch only the scale. The ease of manipulating the instrument when handled in this manner is very gratifying". (Photograph 7).

(12) *Head (transverse)*

"The greatest transverse diameter in horizontal plane which can be found on the vault by the spreading compass (compas d'êpaisseur, Broca or Hrdlička).

"Landmarks: Determined solely by the maximum breadth of the skull above the supra-mastoid and zygomatic crests (Intern. Agr.).

"Method: The instrument is held as in first position for measuring the length, and this position is retained. The left hand is placed lightly on the top of the head of the subject, assisting in bringing the latter into the convenient position for taking the measurement; the instrument is applied horizontally somewhat above what appears to be the maximum breadth,



Photograph 8. Method of Measuring Breadth of Head

and is moved in a zigzag way antero-posteriorly, descending and again ascending by zigzags, until the maximum breadth is found. The eyes watch only the scale. It is necessary to repeat the movements in an ascending and possibly once more in a descending direction, until the observer is positive that the maximum breadth has been ascertained". (Photograph 8).

(13) *Head (height)*[1]

"The height from the middle of the line connecting the floor of the auditory canals to bregma".

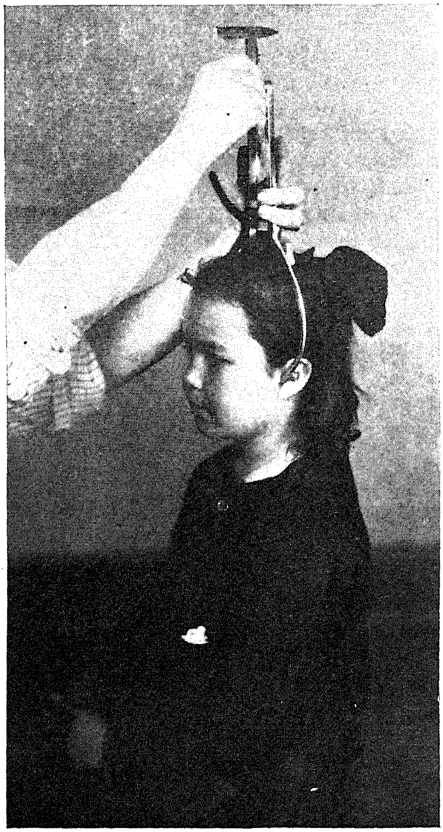
Instrument: The spreading compass of Hrdlička (Photograph 3).

The methods adopted here are those of Hrdlička (406).

"Method: The instrument is held by the right hand just below the joint. The head of the subject being steadied by the left hand, one branch of the instrument is gently introduced into the left ear as far as the guard

1. The Monaco Agreement stipulates that the height of the head be taken from "the superior border of the auditory opening" to the "vertex;" but no satisfactory method for taking the measurement is offered or has ever been devised. The method here described has been practiced by the author since 1898 and found quite effective.

permits, and the same is followed with the right ear. The compass is then slightly raised to assure penetration as far as the guards allow, is taken hold of a short distance above the scale by the left hand, allowed to sag down by its own weight and held in position. The ulnar side of the hand that holds the compass should for greater steadiness repose on the head of the subject behind the instrument. The scale of the compass is now brought as near as possible over the bregma, the spread of the branches of the compass is noted on the scale, the distance from bregma to lowest part of the scale is carefully ascertained by the rod of the sliding compass, and the operation is completed. All that is now necessary is to read off on a previously prepared scale the total height from the



Photograph 9. Method of Measuring Height of Head

base line of the points of the compass to the lowest part of the scale of the same at the spread observed in the subject at hand, and to deduct from this the distance between the bregma and the scale. Special care

must be exercised that neither of the branches, particularly that in the right ear, slips out of the meatus. (Photograph 9).

"This method is readily learned and causes the minimum of inconvenience to the subject (particularly if the points of the instruments are warmed in water or by the breath of the observer before introduction), and with due care it gives results which vary within less than 3 mm. The time required is scarcely more than the average time for ascertaining the head length. The external portions of the floor of the meatus, while not as perfect landmarks as could be desired, give with this method and instrument, in the writer's experience, results that are more satisfactory than those obtained by any other method or instrument so far devised for taking this important measurement of the head. The preference of bregma to the vertex for the superior 'point de repère', is in accordance with the Geneva Agreement, which stipulates two heights of the vault and both to the bregma."

(14) *Chest (width)*

The methods adopted here are those of Hrdlička (406).

"Transverse diameter: Subject stands in natural, easy, erect position. The forearms are flexed at about right angles, and the arms are lifted forward and upward to about 30 degrees from the body. They are directed to be held limp without any tension, and the examiner satisfies himself that there is no tension by lightly taking hold of the forearms and moving the arms slightly up and down. The object of the position is on the one hand to relax all the thoracic muscles, and on the other to permit the application of the instrument. The same position in every respect is preserved for the antero-posterior diameter.

"The *large compass* is now applied to the chest in such a way that its rod lies directly over the nipples (or corresponding line in women), the fixed branch is pressed against the thorax until it meets with the resistance of the ribs, and the right branch is applied repeatedly to the opposite side of the thorax, with equal pressure, during inspiration and expiration until the medium between the two can be arrived at. It is the medium which is recorded. The instrument is held so that its plane is at right angles to the vertical plane of axis of the thorax.

(15) *Chest (depth)*

The antero-posterior diameter is taken so that the fixed branch of the compass is applied to the nipple line, the rod of the instrument to the ribs on the left side, and the movable branch to the posterior part of the thorax, the instrument being held again at right angle to the vertical axis of the chest. Here also we take repeated measurements until the medium between normal inspiration and expiration is ascertained, and this is recorded."

D. CIRCUMFERENCE

(16) *Head.* The circumference of the head is taken at the greatest distance over the frontal and occipital processes, the tension of the tape being regulated by practice or by the observation of the spring indicator on the tape.

(17) *Chest.* The circumference of the chest is taken, with or without clothing, at the nipple line for boys and at a corresponding height for girls.

E. WEIGHT

(18) *Body Weight.* The weight is taken with or without clothing. When clothing is included, the shoes and coats are removed. Clothing for children below 12 years of age weighs on an average .75 kgs. and for children over 12 years of age on an average 1.1 kgs.

F. BREATHING CAPACITY

(19) *Lung Capacity Minus Residual Air.* The measurement has been taken in the usual manner, with conditions standardized as far as possible, using the wet spirometer, which gives the volume of lung capacity minus the residual air. Mr. A. W. L. Bray, who began his work at the Station on January 1st, 1921, as a Research Associate in Child Welfare, will aim to standardize new instruments and technique. Waldenburg's pneumatometer is being tested out and various other methods of measuring respiratory capacity.

G. STRENGTH

(20-23) Here again the generally used methods for the hand dynamometers have been used. The writer has found the "Martin Method" (Walter Reed General Hospital Monograph I, Washington, D. C., pp. 11 ff.) a promising one, and the Kellogg method used at Battle Creek is also being tried out.

H. INDICES

(24-28) (For a theoretical discussion of indices of growth, see Chapter VI. The *sitting-standing index* is determined by dividing the sitting height by the standing height; the *cephalic index* by finding the ratio of the width of the head to the length; the *chest index* by dividing the depth of the chest by the width; the *vital index* by dividing the breathing capacity by the height; the *weight-height index* by dividing the weight in kilograms by the height in centimeters or by the square or cube of the height.

I. CRANIAL CAPACITY

For the present the Lee and Pearson (468) formula No. 14 is being used. It is

Male. Brain cc.=.000337 (L—11mm.) (B—11 mm.) (H—11 mm.)+406.01.

Female. Brain cc.=.0004 (L—11 mm.) (B—11 mm.) (H—11 mm.)+ 206.6.

4. Health Studies From Iowa Cities

Many communities in Iowa have been stimulated to undertake, in collaboration with the writer, systematic measurements of their school children. The following short studies are included as examples of the Anthropometric Service of the Station.

In coöperation with Superintendent Frank L. Smart of Davenport and Superintendents Z. C. Thornburg and J. W. Studebaker of Des Moines, Iowa, careful physical measurements have been made for two years by the writer and his graduate assistant, Mr. Mayberry, on eighteen physical traits of 1250 children between five and sixteen years of age. The following table gives the mean measurements and indices for 563 children for ten traits for the ages from five to thirteen years, inclusive, for the combined schools, which represent three of the best grammar schools in the state from the standpoint of equipment and the social status of the children.

Comparing the mean measurements of the elementary and grammar school pupils of Davenport and Des Moines (Tables I and II) with the norms in Chapter VI, it will be noted that the boys and girls are shorter and lighter for all ages. In sitting height, the boys are slightly above the norm for ten years and the girls and boys for ten and eleven years. In chest girth, the boys and girls are slightly superior to the norm, probably due to the fact that this measurement includes the thickness of clothing.

In 1917 Mr. F. F. Vasey, who was then superintendent of schools in Charles City, measured 192 boys between 10 and 15½ years of age. Mr. Vasey subsequently became superintendent in Mason City and made there in 1919 a similar study of 139 boys from 13 to 17 years of age.

An analysis of the data from these two studies shows that the Charles City boys are below those in Mason City in stature, from 13 to 16 years of age. In weight they are not only lighter but proportionately lighter for their weight as shown by the weight-height indices. In breathing capacity the Charles City boys are superior; this is particularly marked in proportion to their weight.

From 13 to 14 years of age, the Mason City boys average approximately the same as the *"proposed norms"* for weight, height, and breathing capacity given in Chapter VI of this *Study*. From 14 to 16 years of age, the Mason City boys are slightly above the average in weight, height, and breathing capacity; from 16 to 17

TABLE I. MEAN MEASUREMENTS

ELEMENTARY AND GRAMMAR SCHOOL PUPILS, DAVENPORT AND DES MOINES, IOWA

299 Boys—264 Girls.

Ages		5	6	7	8	9	10	11	12	13
Traits										
Height	Boys	109.9	111.8	119.3	125.9	128.7	133.3	141.0	142.4	147.0
	Girls	107.3	111.0	117.5	121.2	127.9	133.1	139.4	143.7	150.7
Weight	Boys	21.1	19.4	22.0	24.5	26.5	27.0	33.2	34.1	36.8
	Girls	17.2	17.8	20.9	21.6	24.9	27.8	30.3	35.0	37.1
Sitting-height	Boys	61.9	62.3	65.4	67.9	68.7	71.6	74.2	75.6	76.5
	Girls	59.4	61.2	64.5	65.8	69.3	69.9	73.8	75.5	78.7
Span of arms	Boys	107.1	109.2	115.0	121.6	126.4	132.1	139.2	141.7	146.4
	Girls	101.0	105.5	111.7	117.1	122.9	129.2	137.3	141.1	150.2
Chest width	Boys	19.8	19.1	20.1	20.6	21.0	21.5	22.7	22.4	23.1
	Girls	18.4	18.6	19.5	19.5	20.3	21.1	21.8	22.4	22.9
Chest depth	Boys	14.9	14.7	15.4	15.8	15.9	16.1	16.8	16.7	17.8
	Girls	14.2	14.2	14.8	14.8	15.4	15.7	16.3	17.1	17.9
Chest circumference	Boys	61.5	59.6	59.9	61.9	64.0	65.8	70.0	69.1	73.3
	Girls	57.9	59.4	59.6	60.7	61.8	65.4	68.4	73.6	75.8
Head (a) Length	Boys	17.9	17.8	17.8	18.0	18.0	18.2	18.2	18.1	18.5
	Girls	17.4	17.0	17.4	17.6	17.5	17.7	17.8	17.9	18.1
Head (b) Width	Boys	14.2	14.1	14.3	14.5	14.4	14.5	14.5	14.6	14.8
	Girls	13.6	13.8	13.9	14.2	14.1	14.2	14.2	14.2	14.6
Head circumference	Boys	52.4	51.9	51.3	51.5	52.1	52.5	53.5	53.1	53.9
	Girls	49.6	50.1	50.2	50.9	51.3	52.2	52.7	52.7	54.3

TABLE II. MEAN INDICES

ELEMENTARY AND GRAMMAR SCHOOL PUPILS—DAVENPORT AND DES MOINES, IOWA.

Ages / Traits		5	6	7	8	9	10	11	12	13
Weight-height index	Boys	.191 (1.07)*	.173 (.97)	.184 (1.03)	.194 (1.08)	.198 (1.11)	.202 (1.13)	.235 (1.31)	.259 (1.45)	.253 (1.41)
	Girls	.162 (.91)*	.163 (.91)	.178 (.99)	.178 (.99)	.194 (1.08)	.208 (1.16)	.217 (1.21)	.243 (1.36)	.246 (1.37)
Sitting-standing index	Boys	.559	.557	.547	.539	.534	.536	.526	.531	.520
	Girls	.553	.561	.548	.542	.541	.527	.529	.525	.522
Chest index	Boys	.751	.767	.766	.764	.753	.751	.742	.746	.770
	Girls	.773	.762	.761	.761	.758	.744	.748	.762	.783
Cephalic index	Boys	.793	.792	.803	.806	.800	.797	.797	.807	.800
	Girls	.782	.817	.799	.807	.806	.802	.798	.793	.807

* English system.

they are below the average with a wide range of individual differences throughout the group. For example, the largest boy in the 14 year group weighs 65 pounds more than the smallest boy of the same group. The largest boy in the 16 year old group weighs 77 pounds more than the smallest boy of that group. In the 14 year old group the tallest boy is 13.1 inches taller than the shortest boy of that group. In the 14.5 year old group, the tallest boy is 12.3 inches taller than the shortest of the group. In the 14 year group, the boy with the best breathing capacity exceeds the boy with the poorest breathing capacity by 90 cubic inches. In the 16 year group, the boy with the best breathing capacity has 185 cubic inches greater capacity than the poorest boy of the group.

Through the work of Mr. I. J. Price at Mason City, preliminary data concerning the Grammar School boys have been collected up to October, 1919. His analysis of these data may be summarized as follows: The ratio between weight and height and between breathing capacity and height was determined for each pupil. The variations in these ratios is more significant than a variation in any of the single items such as weight, or height, or lung power. A boy may be under "normal weight" and under "normal height" for his age and still have a good ratio. He may be above standard in height at any specific age, and have insufficient lung capacity for his other physical traits. The ratio is a good indicator of the boy's potential health situation.

The distribution of the weight-height indices indicates that as many as 17 per cent of the boys in grammar school are below normal ratios, suggesting poor health.

The vital-height indices of 211 boys of the grammar school show that on an average 55 percent of boys are lower in height and breathing capacity index than is normal.

In Mason City 3000 children are being measured monthly and in a few years consecutive measurements will be available showing the effects of remedial physical training and inspection.

In New Providence, Hudson, Calmar, North Liberty, and in the University Elementary and High Schools of Iowa City, the height and weight and other measurements of the boys and girls approximate the norms in Chapter VI, but the wide range of ages from five to 19 years makes the number for half year periods too few for adequate comparison at this stage of the work.

Through the coöperation of A. L. Urick, the Commissioner of

the Bureau of Labor Statistics of Iowa, the physical measurements on 4727 boys and 2577 girls granted working certificates in the state from July 1, 1918 to July 1, 1920, are given below (Table III) and compared with the writer's norms for 14, 14½, 15 and 15½ years of age.

It will be noted that these boys and girls measure in height up to the standards or above, except at 15 and 15½ years of age; in weight they exceed the norms except at 15 and 15½, when they are below. The norms, however, are for nude children and these children wore clothing and shoes.

TABLE III

MEASUREMENTS OF CHILDREN GRANTED WORKING CERTIFICATES

Age	No. of cases	Average Height	Average Weight	Height-Weight Index
14-14½	Boys 1192	156.26	47.46	.297 (1.66)*
	Norm	154.94	43.05	.279 (1.56)
	Girls 532	157.66	47.73	.303 (1.69)
	Norm	155.70	46.40	.299 (1.67)
14½-15	Boys 1274	159.59	47.18	.290 (1.62)
	Norm	157.99	44.88	.285 (1.59)
	Girls 691	158.62	48.85	.306 (1.71)
	Norm	158.75	47.99	.303 (1.69)
15-15½	Boys 1228	159.66	45.50	.286 (1.60)
	Norm	161.80	47.57	.295 (1.65)
	Girls 674	159.21	49.89	.313 (1.75)
	Norm	159.00	50.02	.315 (1.76)
15½-16	Boys 1033	160.43	49.16	.311 (1.74)
	Norm	166.35	52.56	.319 (1.78)
	Girls 680	159.79	50.95	.310 (1.73)
	Norm	160.78	52.29	.326 (1.82)

* English system.

5. SUMMARY

(1) The international standardization of instruments and methods for taking measurements on living subjects is of paramount importance in the securing of comparable data for a science of physical growth.

(2) The instruments described in this chapter are light, portable and accurately constructed of non-expandable material, graduated in the metric system, which should be universally used for scientific work.

(3) The methods of procedure and technique are universal standards as far as possible at this stage of the work, with definite landmarks indicated.

(4) Twenty-three measurements are selected and described for an international basis for anthropometric work in child welfare.

(5) An anthropometric service laboratory has been organized for physical measurements and their evaluation on infants and children of so-called normal and superior development, the aim being to secure normal standards for American children.

(6) The comparative type studies from Iowa show these children to be on the average slightly below the normal standards which are given in the subsequent chapters.

(7) These studies in individual growth furnish a basis for clinical studies in nutrition and physical development.*

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* The University of Iowa, through its Child Welfare Research Station and Extension Division has formulated a coöperative plan to assist school officers and parents in the State in recording and evaluating the semi-annual physical measurements of the growth of their boys and girls, between the ages of 5½ and 18 years. These measurements which are few and simple, offer the best indices of growth, health and nutrition. The measurements are to be taken in the school by the medical inspector or the teacher of mathematics or science who should be especially accurate. The cards are forwarded in June to the Extension Division and the Research Station records the results, compares them with standards for Iowa children and returns the cards and tabulated results with critical comments through the Extension Division.

The essential principle of the plan lies in the coöperation between the University specialists and the school or parents, affording continuous observations on the same children for periods from one to twelve years. In no homes or schools in the United States have an appreciable number of children been measured consecutively. Iowa is the first state to organize as one phase of its child welfare work, a standardized method for repeated measurements on the same boys and girls for long periods of time, resulting in *individual history* curves of scientific value. An extension of the plan will be issued subsequently, to include a similar method for the measurement of infants from birth to six years of age.

Arrangements can be made by the larger school systems of the state to have a limited number of the staff trained by the Research Station at the University or through the institutes, in accurate methods of making and recording data on the measurements to be taken.

The individual growth cards of the child whose measurements are recorded, follow one child from grade to grade in school, or from one portion of the state to another, if a change of locality becomes necessary. No expense is involved except for the cost of the individual record card, which may be used for twelve years, and the postage on the part of the school or parent that sends the cards to the University. For details of this work see Extension Bulletin No. 59.

PART II

CHAPTER III

THE GROWTH OF INFANTS

That children grow more in proportion to their initial size at birth during the first year than at any subsequent period is generally recognized. It is also known that the number of cells in the human species tends to become fixed after two or three years, (215) and from that time on growth is a condition of cell enlargement. Beyond some general information as to growth in weight and length, there is little knowledge of just how small children grow. While several physicians have published growth charts of infants, all with the exception of a few weight norms are based on single measurements of different individuals and the average of such measurements gives little real insight into the characteristic trend of individual growth curves. Realizing the great need for individual growth curves from birth to seven years of age, the Research Station has started such measurements.

It is not only difficult to measure babies accurately, but it is also

Photograph 10. Preparing to Measure a Baby

a problem to know what measurements to make, what are most significant. These should be selected always with the ultimate purpose in view. After preliminary trials and after consulting the litera-

ture in search for the measurements that are most needed and can be taken most accurately, the writer has decided to measure the first 18 traits given on pages 18 and 19. The length of the arm and of the leg is difficult to obtain accurately on account of localizing the acromion ad trochanter points. The chest circumference is necessarily approximate, since the texture of the body and the tautness of the tape vary from time to time. The position of the child is difficult to standardize and the reclining length is longer than the standing length. In most instances it is necessary to adapt

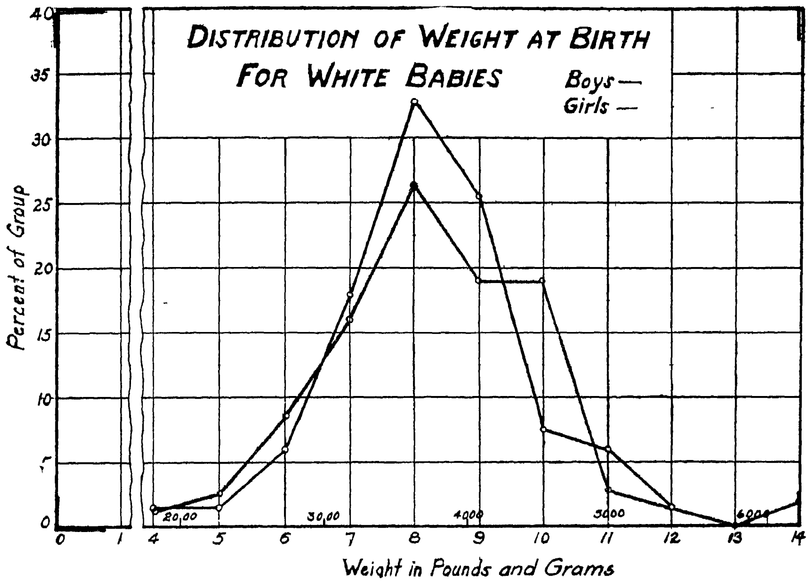

Chart 1

the instruments for measuring infants, since the skin is so sensitive to pressure and cold. The height of the head is a particularly difficult measurement to make on an infant and should not be undertaken except with great caution.

I. HOW INFANTS GROW IN WEIGHT

1. Data and Method of Study

a. *Source of Data.* After searching through several Departments of Pediatrics in the hospitals of this country for good consecutive records, the writer found, prior to his coming to Iowa, a group of

approximately 5000 babies that had been weighed at frequent intervals at the Baby Milk Fund Association of Baltimore, by physicians under the direction of Dr. Mason Knox, Jr., from the Johns Hopkins Hospital Clinic, of which Dr. John Howland is chief. From this group were selected all who had been weighed at least monthly during the first year; of these many were measured weekly. Two hundred of each race and one hundred of each sex were selected on the basis of the frequency of the number of measurements and the amount of supplementary data in regard to diet, diseases, nationality, and other recorded facts. The results gave approximately 5000 weight measurements, and the individual growth curves offer a basis for more detailed scientific study in connection with work at the Research Station where a number of normal babies in the

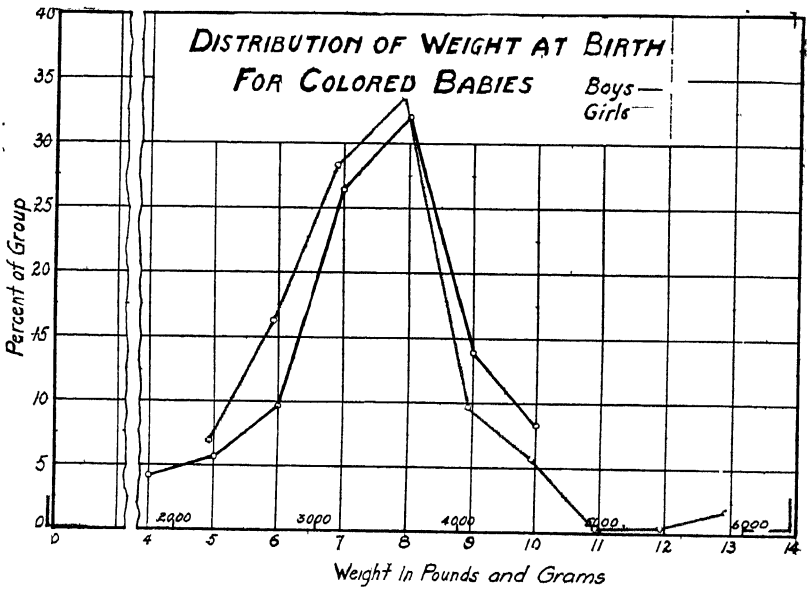

Chart II

homes of Iowa City and in the University Hospital are now being measured.

b. *Distribution of Weight at Birth.* Charts I and II, pages 35 and 36 show the distribution of weight at birth of the white and colored babies, boys and girls. It will be noted that the mode for each of the four groups is 3629 grams. The average for the white boys is 85 grams less than for the white girls. The colored boys are slightly

heavier than the colored girls, who are 364 grams lighter than the white girls on the average. The range of distribution, it will be noted, is from 1814 to 5443 grams for the white boys and from 1814 to 6350 grams for the white girls; for the colored boys the distribution is from 1814 to 4536 grams, for the colored girls from 2268 to 5897 grams.

2. White Female Babies

a. *Effects of Artificial Feeding.* The white female babies show, on the average, a steady increment of growth during 23 weeks when there is no appreciable gain for several weeks. There is also a

Table IV

MEAN-WEIGHT AND MEAN DEVIATION OF 100 FEMALES—WHITE

Number of Cases	Age in Weeks	Grams	
		Weight	Mean Deviation
67	Birth	3714	559
9	1	3317	454
27	2-3	3770	491
37	4-5	4082	403
38	6-7	4111	479
44	8-9	4451	680
59	10-11	4763	632
51	12-13	4904	658
71	14-15	5245	777
57	16-17	5471	703
56	18-19	5755	870
45	20-21	5982	961
58	22-23	6265	870
58	24-25	6265	1004
55	26-27	6520	1021
51	28-29	6747	930
59	30-31	7059	947
49	32-33	7258	919
53	34-35	7172	794
45	36-37	7484	743
47	38-39	7683	808
42	40-41	7938	836
40	42-43	8023	921
33	44-45	8335	879
32	46-47	8335	802
30	48-49	8647	876
26	50-51	8788	961
35	52-53	8902	876
29	54-55	8930	1058
15	56-57	9015	794
1303			

diminution in the increment of growth for the 53 weeks. The artificially fed babies of this group, who, like the others, are at this period under the supervision of the physicians in charge, grow less rapidly just after birth, but tend to reach the normal weight toward the end of the first year. At the twentieth week, all but four out of 15 weighed at least 907 grams less than the average weight for that week; and at the end of the year, seven out of 10 weighed within 454 grams of the average or more. It is fairly certain that these artificially fed babies do not recover so quickly from the diseases which beset them as do the breast fed babies. A single attack of bronchitis or diarrhea may retard the normal growth for a month or more, while many of the apparently healthy breast fed babies will lose no weight at all unless complications arise.

b. *Effects of Disease.* The acuteness and duration of the disease, the nursing, the medical care and home conditions, together with the native vitality of the babies, no doubt have much to do with the manner in which the diseases affect growth and health, but some supplementary facts may be gleaned by including the disease histories recorded. For white girl babies, whooping cough and pneumonia apparently are serious in their effect on growth; recovery is slow and several months elapse before the child shows normal increase in weight. Constipation, intestinal indigestion and vomiting are usually accompanied by a slight loss in weight, but recovery is ordinarily rapid. When diarrhea occurs at the same time, it may be several weeks before normal growth is resumed. Diarrhea alone does not seem to have much effect on the weight of the otherwise healthy child. So also with the other diseases; if they occur singly the child usually maintains its normal growth, though it will seldom exceed it; when a child has two or more diseases, as is frequently the case, the weight is apt to fall below the average. These facts are given as supplementary data, and no direct conclusions can be drawn from them.

3. White Male Babies

The average weight for the white boy babies at birth is 85 grams less than for the white girls, but the gain at first is more rapid, so that in the six to seven weeks period the boys are about 368 grams heavier than the girls. From that period to the end of the first year, their weights increase with equal rapidity, the average for the boys being, however, 454 grams ahead of the girls.

TABLE V

MEAN WEIGHT AND MEAN DEVIATION OF 100 MALES—WHITE

Number of Cases	Age in Weeks	Grams	
		Weight	Mean Deviation
71	Birth	3629	490
5	1	3827	417
37	2-3	3799	448
41	4-5	3969	493
47	6-7	4479	536
63	8-9	4848	544
69	10-11	5075	553
67	12-13	5358	627
61	14-15	5642	683
64	16-17	6038	822
44	18-19	6294	683
65	20-21	6407	751
66	22-23	6691	765
48	24-25	6776	958
57	26-27	7059	754
49	28-29	7172	800
45	30-31	7626	890
45	32-33	7541	788
43	34-35	7853	904
28	36-37	7966	819
40	38-39	8250	709
32	40-41	8477	836
24	42-43	8760	697
29	44-45	8732	573
29	46-47	8788	539
24	48-49	8817	953
21	50-51	9270	683
24	52-53	9299	930
20	54-55	9214	451
21	56-57	9440	649
15	58-59	10121	689
1294			

a. *Effects of Artificial Feeding.* Artificial feeding for this group apparently shows less effect on the boys than on the girls. Only six out of 15 weigh 907 grams less than the average at 20 weeks and at the end of the year all but two out of 13 are within 454 grams of the average. Also very few illnesses are recorded for these 15 babies. There is one case of whooping cought and one of pneumonia, and in both cases loss of weight is slight and recovery rapid. There is, therefore, some indication that even at this early period these boys are more robust than the girls.

b. *Effects of Disease.* The number of illnesses recorded for the white baby boys is less than two-thirds of the number recorded for white girls. The general effect of the different diseases on growth is apparently about the same as in the case of the girls. Such diseases as pneumonia, whooping cough, mumps, and measles may stop growth as indicated by weight for a month or two, but if the child is strong, recovery is very rapid.

The growth of these infants shows the same relationship to diet that was found in the case of the girls. Providing the mother has sufficient milk, the child's weight increases consistently for six or seven months. In most cases the boys have been given supplementary food, such as cow's milk, zwieback, cereals, and broth sometime between the sixth and ninth months, and in only a few cases has additional food been withheld until the eleventh month. Consequently, there are not so many cases which show the tendency for the growth to diminish during the ninth and tenth months as were found in the case of the girls who were entirely breast fed until the eleventh month.

4. Colored Female Babies

The average weight for colored girl babies at birth is 3340 grams, which is 68 grams lighter than for colored boy babies at birth. The difference in weight between colored boys and colored girls continues negligible down to about the sixteenth week, when the difference is 284 grams. The boys are from 284 grams to 567 grams heavier from the sixteenth week to about the thirty-fifth week; from that time on the sexes differ less and less until at the fifty-second week the average weight for girls is 8474 grams and for the boys 8423 grams. The amount of difference between the average weights of the colored girls and the white girls varies a great deal. The white girls are heavier at birth, but the difference becomes less shortly after. From the period between the sixth and sixteenth weeks to the end of the first year the white girls are heavier, with the difference gradually increasing until at the end of the fifty-second week the white girls weigh 454 grams more than the colored girls.

The individual weights for the colored girls, as for the colored boys, show more irregularity than the weights of the white girls.

a. *Effects of Artificial Feeding.* Fifty per cent of the 16 artificially fed babies are 907 grams or more lighter than the average weight at 20 weeks, and at the end of the year

TABLE VI

MEAN WEIGHT AND MEAN DEVIATION OF 100 FEMALES—COLORED

Number of Cases	Age in Weeks	Grams	
		Weight	Mean deviation
70	Birth	3340	445
18	1	3439	377
55	2-3	3496	493
44	4-5	3892	374
56	6-7	4159	553
48	8-9	4590	559
44	10-11	4794	559
43	12-13	4964	646
48	14-15	5395	610
48	16-17	5299	842
50	18-19	5681	890
42	20-21	5778	808
54	22-23	6265	822
41	24-25	6124	870
42	26-27	6447	933
37	28-29	6362	1089
44	30-31	6736	958
38	32-33	7133	947
29	34-35	7022	936
45	36-37	7351	783
38	38-39	7450	902
28	40-41	7717	848
32	42-43	7552	720
39	44-45	8083	907
22	46-47	7978	853
27	48-49	8054	944
35	50-51	8304	771
32	52-53	8474	771
27	54-55	8341	978
20	56-57	8431	819
22	58-59	8375	890
1214			

there are still seven out of 14 who are decidedly below average. The records show that several of the mothers worked or boarded out, which would interfere with the regularity of feeding and proper care, and this might account for the fact that these babies did not gain so much weight as the white babies who were artificially fed.

b. *Effects of Disease.* There are only half as many illnesses recorded for these colored girls as for the whites. The most frequent disease in every case is diarrhea, although it seldom has much

effect on growth in weight. Four out of 116 babies died during the first year, one from pneumonia and one from intestinal indigestion; in the case of the other two, no cause was given. It is probable that the record of illness is not complete, a fact which would partially account for the apparently more healthy condition of the colored girls.

The diet records show greater dependence on milk in some form for additional nourishment during the first 11 months than in the case of the white girl babies. In most cases the babies are given condensed milk or modified cow's milk besides the breast feedings, soon after the sixth month. Many of the white girl babies are given cereals, broth, rice, potato, or bread, but only a few colored babies are given this kind of food until the end of the year. This may have something to do with the fact that the white girls are heavier the last six months, although the colored babies are heavier up to the fifth month.

5. Colored Male Babies

The weights for colored boys show more irregularity in growth than in the case of white boys. The average weight at birth for the colored boys is 3408 grams and for the white boys 3629 grams. Throughout the year the difference in weight varies a great deal, but the average weight for the colored boys is less than that of the white boys at every period except the 24 to 25 weeks period when it is just the same. The general tendency, however, is for the difference to be greater as the children get older. For example, at birth the difference is 221 grams, at the 16 and 17 weeks period it is 447 grams, and at the 52 and 53 weeks period it is 876 grams.

The individual cases show the same irregularity in growth. There will be several weeks during which the increase in weight will be negligible, and no disease will be indicated on the record. The number of illnesses recorded for the colored boys is just about the same as for the white boys. Apparently, their growth is more retarded by home conditions and a general lack of care than an unusual amount of sickness.

a. *Effects of Artificial Feeding.* In the case of the colored boys, more of the artificially fed babies are below normal than in the case of the white boys. Out of 11, eight are more than 907 grams below average weight in the twentieth week. At the end of one year, six are still 907 grams or more below average, although the

TABLE VII

MEAN WEIGHT AND MEAN DEVIATION OF 100 MALES—COLORED			
Number of cases	Age in weeks	Grams	
		Weight	Mean Deviation
60	Birth	3408	479
15	1	3473	508
52	2-3	3558	564
46	4-5	3924	649
40	6-7	4088	734
53	8-9	4584	737
49	10-11	4950	765
47	12-13	5165	882
40	14-15	5162	1055
41	16-17	5591	938
50	18-19	5936	961
39	20-21	6109	981
46	22-23	5973	941
42	24-25	6792	822
39	26-27	6926	785
35	28-29	6849	839
42	30-31	7190	882
35	32-33	6991	964
37	34-35	7436	1052
32	36-37	7371	879
35	38-39	7558	984
31	40-41	7669	848
29	42-43	7660	930
27	44-45	8051	953
27	46-47	8343	947
27	48-49	8219	828
25	50-51	8386	936
34	52-53	8423	683
29	54-55	8771	975
17	56-57	9001	788
1121			

only illnesses recorded for these babies are one case of whooping cough and one of thrush.

b. *Effects of Disease.* The number of serious illnesses is much greater than for the white boys. There are 12 cases of pneumonia recorded, four times as many as for the white boys, and of those eight died. Six others died from diseases which are not recorded for the white babies, such as cholera infantum, tuberculosis, lues, and marasmus. The effect of the more common diseases, such as diarrhea, bronchitis, eczema, whooping cough, measles, and

constipation is practically the same as for the white boys, loss of weight is very similar and recovery is equally rapid.

6. Individual and Average Growth Curves of White Male and Female Babies

The three boys whose weight curves are given in Chart III are taken from the group of 100 whose averages have been given on page 39. Their measurements extend over the year period in most cases, but the curves have been limited to 52 weeks' measurements on the same individuals at more or less regular intervals.

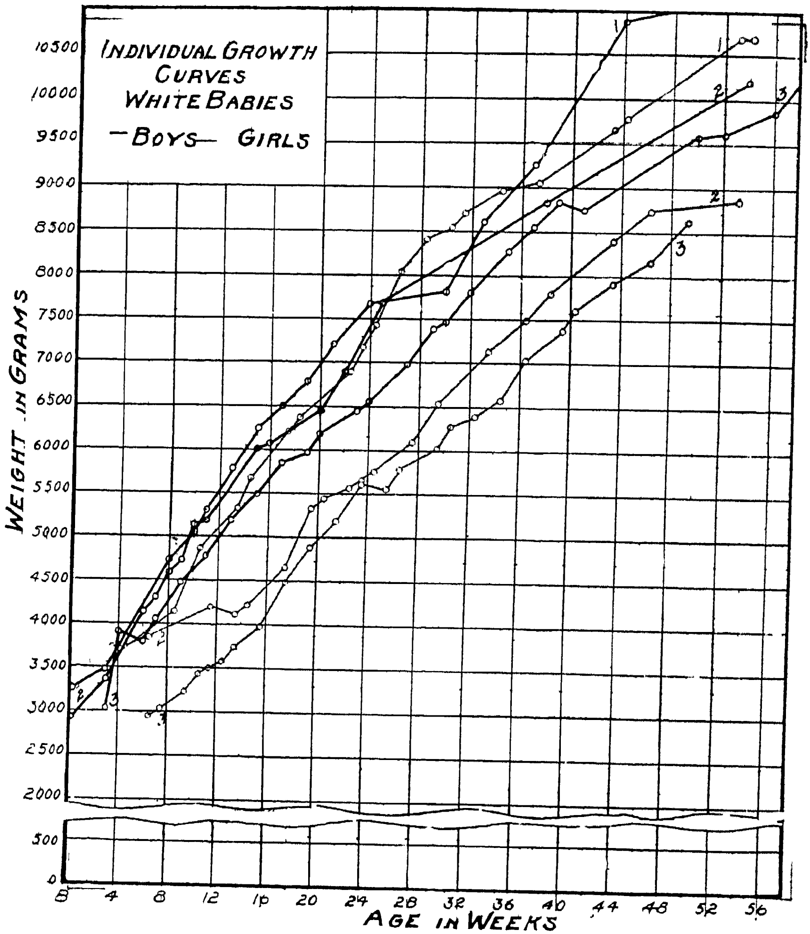

Chart III

The heaviest boy (*1*), of Hebrew parentage and a twin, weighed 3288 grams at birth and grew in a normal healthy manner until the end of the year, when he weighed 11,113 grams. There was a slight drop in weight after August. He was breast fed with a milk formula at six months and some solid food at nine months. At the end of the year he was taking soft food and the breast. There were no intercurrent illnesses during the year. There were eight living children, all breast fed. The father was 40, the mother 38 years of age.

The second boy (*2*), a Russian Hebrew, also shows good healthy growth in weight. His birth weight was 2948 grams, and he was breast fed during the year, with a soft diet at 12 months, and there were no intercurrent illnesses. At 12 months he weighed 10,087 grams. This boy also shows a slight falling off in weight after 24 weeks (August-September). At the end of the year his diet consisted of milk, soup, zwieback, and oatmeal. The father was 28 and the mother 26 years of age and there were two living children, breast fed.

The third boy (*3*) is also of Russian descent. His weight at birth is not recorded, but at the end of the second week he weighed 3062 grams. He had an abscess in the right axilla at four weeks, and suffered from constipation at nine weeks, bronchitis at 24 weeks and acute coryza at 40 weeks. After 32 weeks he was fed cereal every three hours, the breast feeding having been discontinued. The father was 27 and the mother 21 years of age. This was the only child.

The girls' curves of growth in weight (Chart III page 44) are slightly below those of the boys and are slightly more irregular. Number (*1*), of German descent, weighed 3402 grams at birth and 10,659 grams at the end of the year. She was breast fed for eight months, after which a cow's milk formula was used. She had no intercurrent illness and was the only child of young parents, aged 22 and 23 respectively.

The second child (*2*), of American parentage, shows a relatively high weight at the third week, the birth weight being unknown. At the end of the eighth week the mother's milk was exhausted and cow's milk was substituted. The child never regained its relative position in weight. There was no illness during the year. The father and mother were 28 and 29 years old respectively.

The third girl (*3*), of German Hebrew parentage, was given con-

densed milk from the first, as "the mother's milk did not agree with the baby." Later cow's milk and at seven months broth, zwieback, and cereal were given. She had no intercurrent illnesses. Growth is steady and uniform, although the child is relatively light. Both parents were 27 years old and there were no other children.

In this group of babies there is a wider range of distribution than with the previous group. No. (*1*) of American descent, is a large, fat boy, weighing 4536 grams at birth and 11,567 grams at the end of the 52 weeks. He was breast fed and had no illness except diarrhea at 28 weeks, followed by a slight loss in weight. He was breast fed with supplementary cereals and soft food after 32 weeks. The father was 32 years of age and the mother 28. There was an older child.

The second boy (*2*), a Russian Hebrew, weighed 2948 grams at birth. While he was small, growth was good for the first 30 weeks, when there began a slight diminution. No diseases were present during the year. He was breast fed for nine months, with cereal and zwieback, beginning at six months, broth and eggs at nine months and soft food at 12 months. The father was 20 and the mother 19 years of age and this was the only child.

The largest girl (*1*) was large at birth, weighing 5216 grams, with a subsequent history of bronchitis at 23 weeks, rhinopharyngitis at 40 weeks and ilio-colitis at 52 weeks. She was breast fed for the first 16 weeks, when cow's milk was substituted, followed by cereals and finally protein milk. The child was not taken for observation until 12 weeks (June 27th) when it weighed 5727 grams, having gained but 510 grams during the period of 13 weeks. The value of subsequent observations and directions is self-evident. There were four children, two of whom had died in infancy. The parents were 33 years old respectively.

The second girl (*2*), of German Hebrew descent, weighed 3402 grams at birth and 9129 grams at the end of the year. She was breast fed for seven months, was then given cereals and broth and later soft food. There is a dropping off in the relative weight after the 24th week (August 26th). She was the only child of parents aged 29 and 26 respectively.

The smallest girl (*3*), of American descent, weighing 1814 grams at birth, was immediately brought to the Station at the end of the first week and grew rapidly until an acute illness at 34 weeks. This girl was breast fed for eight weeks, when the mother's milk failed

and condensed milk was substituted. There were three children of whom one, bottle fed, died. The father was 30 years of age and the mother 29.

7. Individual and Average Growth Curves of Colored Male and Female Babies

In this group of three colored boys, the measurements in weight extend, like those of the white boys, from birth to 56 weeks but the

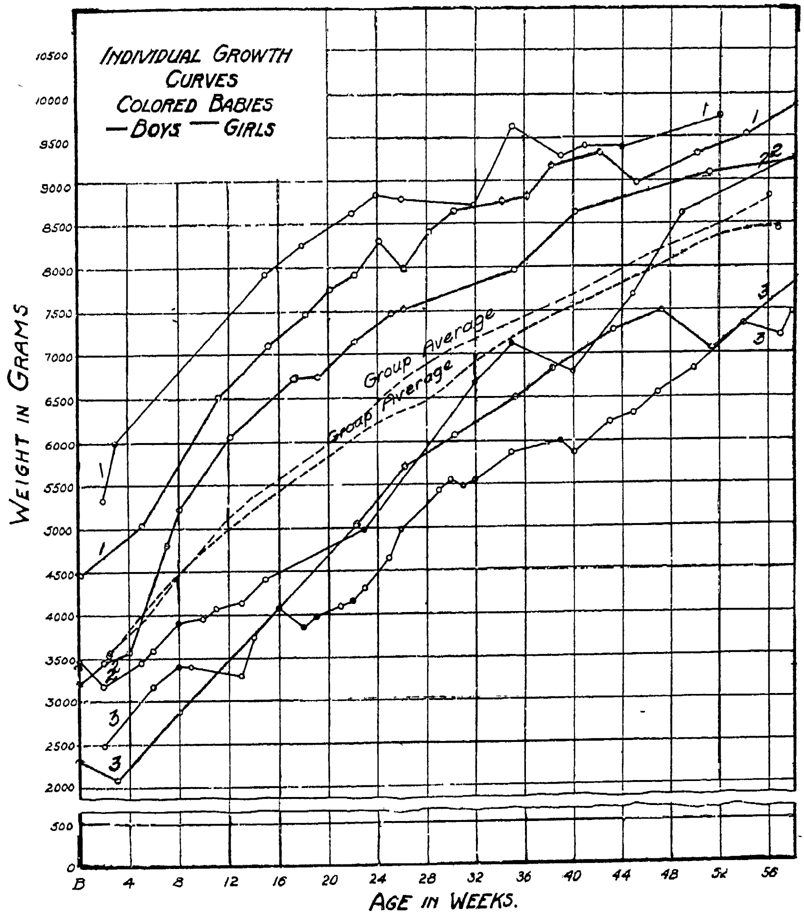

Chart IV

number of regular observations is less except in the case of the third. The birth weight of the largest (*1*) was not known, but at

the end of two weeks he weighed 5330 grams and at the end of the year 9752. No illnesses are recorded and the baby is an unusually large one. He was the last born of six children, two having died; all were breast fed. The father was 38 years of age, in good health and the mother 36, in good health.

The second colored boy (*2*) weighed 3515 grams at birth and grew steadily and fairly uniformly until he weighed 9979 grams at the end of the first 68 weeks. He had no serious diseases. He was breast fed for the first two weeks only, when cow's milk was substituted. He was the second child and both parents were 32 years old.

The third boy (*3*) was small, weighing 2495 grams at the end of two weeks; he had little or no illness except thrush at 45 weeks and grew well under careful observation during the 28 visits to the Station. He lived on condensed milk for eight weeks, cow's milk until 36 weeks and cereal and soft food after this. His parents were said to be healthy. The father was 40 years old and the mother 17 years old.

The growth curves for weight in this group of non-selected colored girls are more regular than for the boys, and the range is smaller. No. (*1*) weighed 4423 grams at birth and 9866 grams at the 56th week. No illness was apparent and she was breast fed for the first 48 weeks with supplementary feedings of cow's milk after 16 weeks and cereals at 44 weeks. Her mother brought her frequently to the Station for observation and for advice for herself. The father was 38 and the mother was 27. This was the only child.

The second girl (*2*) weighed 3175 grams at birth and 9979 grams at the 83rd week. No serious illness is recorded. She was breast fed for 36 weeks. The parents were young, the father being 20 and the mother 18 years of age; this girl was the first child.

The smallest girl (*3*) did not make many visits to the Station —12 during the 56 weeks. No illness is recorded. She was breast fed for 52 weeks. She was the second child, the parents being 33 and 21 respectively.

8. Distribution of Recorded Prevalent Diseases

Table VIII

DISTRIBUTION TABLE OF PREVALENT DISEASES RECORDED DURING FIRST 57 WEEKS (400 BABIES)

Diseases	White boys Number of times disease appears	White girls Number of times disease appears	Colored boys No. of times disease appears	Colored girls No. of times disease appears
Diarrhea	11	34	8	11
Eczema	4	37	4	3
Vomiting		8	4	2
Bronchitis	8	7	5	3
Whooping cough	2	7	2	3
Constipation	3	6	2	2
Otitis media	4	4		5
Coryza	2	4	1	1
Intest'l indigest'n		3		2
Cough		3	1	
Pneumonia	4	3	12	4
Measles	1	2	4	
Colds	1	2	1	3
Chicken pox		2		1
Scarlet fever		1		
Acute mastoiditis		1		
Pharyngitis	1	1		
Rhino-pharyngitis		1		
Thrush	3		1	
Tonsilitis	2			
Impetigo	2			
Abscess	2			
Sore throat	1			
Mumps	1		1	
Cervical adenitis	1			
Furunculosis	1			
Convulsions			2	2
Rickets			3	2
Stomatitis				1
Rales				1
Rash on face				1
Eruptions				1
Poliomyelitis			2	
Cholera infantum			1	
Osteomyelitis			1	
Pyloris stenosis			1	
Papular eruption			1	
Sup'rat'g parotitis			1	
Arthritis			1	
Syphilis			2	
Marasmus			1	
Tuberculosis			1	
Total	54	126	63	50

9. Computation of Correlations for:

a. *White Females.* For the white baby girls the coefficients of correlation* between the weight at birth and weight at 14-15 weeks is + .537 with P. E. ± .082; between weight at birth and the 34-35 weeks + .124 with P. E. ± .117; and between weight at birth and the 52-54 weeks + .436 with P. E. ± .113.

b. *White Males.* The coefficient of correlation between weight of white baby boys at birth and weight at 14-15 weeks is + .263 with P. E. ± .110; between weight at birth and the 34-35 weeks + .077 with P. E. ± .125; and between birth and the 46-47 weeks + .308 with P. E. ± .139.

c. *Colored Females.* For the colored baby girls the coefficient of correlation between weight at birth and weight at 12-13 weeks is + .584 with P. E. ± .108; between weight at birth and the 34-35 weeks, + .045 with P. E. ±.077; and between weight at birth and the 52-53 weeks, ± .481 with P. E. + .118.

d. *Colored Males.* For the colored baby boys the coefficient of correlation between weight at birth and weight at 14-15 weeks is + .649 with P. E. ± .075; between weight at birth and the 35-36 weeks, +.413 with P. E. +.107; and between weight at birth and the 50-51 weeks; + .191 with P. E. ± .135.

10. Conclusions

This study of 4800 consecutive measurements in weight on 200 white babies and 200 colored babies approximating normal development shows that for this group:

I. For these infants at birth, the boys and girls weigh approximately the same. The white boys gain in weight more rapidly than the girls and are 454 grams to 681 grams heavier from the second month to the thirteenth month. The colored boys are from 284 to 567 grams heavier than the girls between the fourth and ninth months, but lose this advantage by the end of the year.

II. For this group of infants the colored babies, both boys and girls, weigh on an average 227 grams less than the white babies. This difference becomes greater until at the end of one year the colored babies weigh from 454 to 907 grams less than the white babies, both boys and girls.

III. As a rule, the babies that are relatively heavy at birth are

* Pearson formula.

heavy at the age of four months, and those that are light at birth remain relatively light. On an average, these boys double their birth weight at the end of the seventh month, and the girls at the end of the eighth month.

IV. The coefficients of correlation between weight at birth and weight in the 14 to 15 weeks period are, for white girls +.537, for white boys +.263; for colored girls +.649, and for colored boys +.584. This coefficient decreases as we approach the 34 to 35 week periods, until with the end of the year there is no positive correlation for this group of children. It is not possible to prophesy with a high degree of assurance that if one of these children is heavy at birth, he or she will be relatively heavy at the end of the first year.

V. From 60 to 70 per cent of the babies who are above the average weight at the beginning of the first year are still above average at the end of the year and vice versa, with considerable individual variation within these ranges. They vary a great deal as to the amount they are above or below during this period.

VI. These artificially fed babies as a rule weigh less than the breast fed babies; this is particularly noticeable during the first few months.

VII. The individual growth curves during the first year show a wide range of individual and racial differences at all weekly periods.

11. Supplementary Data Based on Group of Infants Studied

1. The most frequent infant disease recorded for these children is diarrhea, but this has no serious noticeable effect on growth if checked soon and no other complications set in.

2. Bronchitis, constipation, indigestion, otitis media, coughs, and colds, retard growth if allowed to continue for several weeks.

3. Pneumonia is a serious disease from the standpoint of growth for these infants. It occurs more frequently with the colored children than with the white. There are seven cases of pneumonia reported for the white babies and 16 for the colored babies.

4. The white girls show 50 per cent more illness recorded than the white boys.

5. For this group of children, digestive disturbances are more important in interfering with growth than are respiratory disturbances.

II. COMPARATIVE NORMS FOR INFANTS

1. Sources of Data

The infant growth curves for height for boys and girls fro[m] Baldwin, Crum, Variot and Fliniaux and Schmid-Monnard are i[n]cluded in this section of the study for comparative purposes.

2. Growth Curves in Height—Males and Females

Chart V, below, represents the height of infants according t[o]

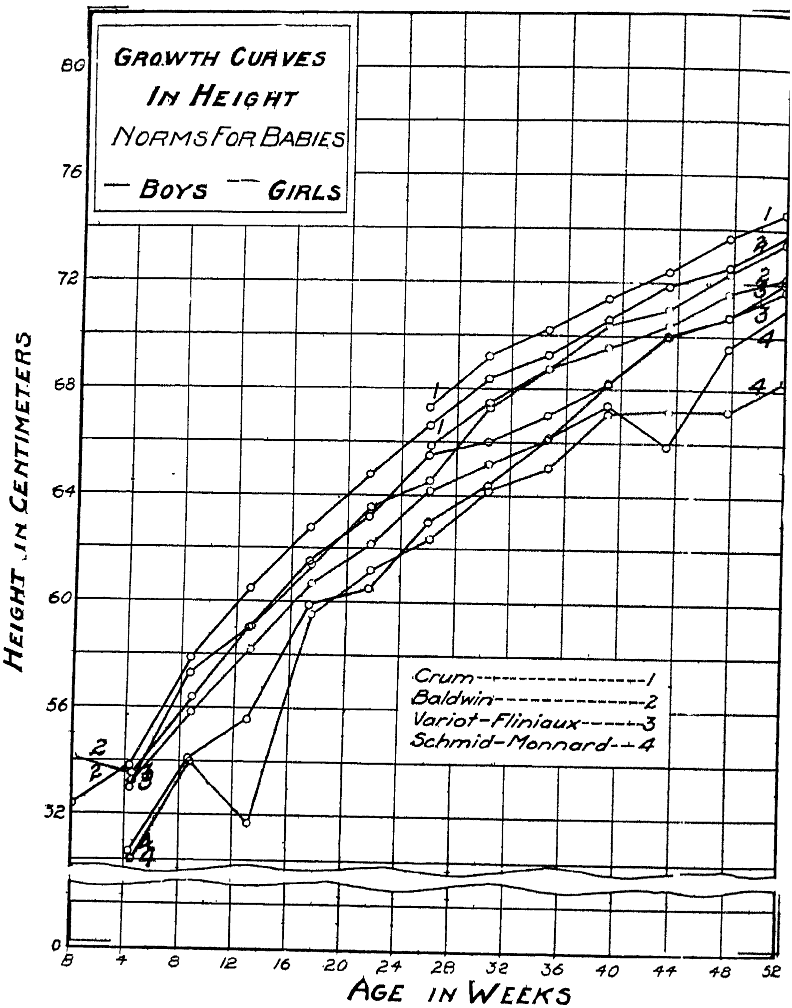

Chart V

these investigators, the black lines showing the growth of boys and the red lines the growth of girls. The norms of Baldwin (*2*) derived from a study of infants in the 99 counties of the State of Iowa are here published for the first time. The methods of collecting these data are described on page 58. The figures used for constructing the growth curves of Crum (*1*) are taken from his Anthropometric Table compiled for the American Medical Association from the measurements of children in 31 states—usually at baby

TABLE IX

HEIGHT AND WEIGHT OF IOWA INFANTS
4682 Boys; 4392 Girls; Total 9074

BOYS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	29	52.38	4.00	.076(.42)*
Under 1 month	124	53.83	4.15	.077(.43)
1 month under 2 mos.	307	57.93	5.15	.089(.50)
2 mos. under 3 mos.	341	60.50	5.92	.098(.55)
3 mos. under 4 mos.	408	62.81	6.49	.103(.58)
4 mos. under 5 mos.	364	64.76	7.10	.110(.63)
5 mos. under 6 mos.	393	66.52	7.50	.113(.63)
6 mos. under 7 mos.	399	68.38	8.03	.117(.65)
7 mos. under 8 mos.	413	69.25	8.36	.121(.68)
8 mos. under 9 mos.	368	70.62	8.68	.123(.69)
9 mos. under 10 mos.	370	71.94	8.95	.124(.69)
10 mos. under 11 mos.	394	72.60	9.11	.125(.70)
11 mos. under 12 mos.	376	73.80	9.40	.127(.71)
12 mos. under 13 mos.	396	74.69	9.54	.128(.72)

GIRLS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	24	53.87	4.25	.079(.44)*
Under 1 month	95	53.34	3.98	.075(.42)
1 month under 2 mos.	278	56.21	4.63	.082(.46)
2 mos. under 3 mos.	345	58.88	5.39	.092(.51)
3 mos. under 4 mos.	392	61.23	6.04	.099(.55)
4 mos. under 5 mos.	380	63.36	6.58	.104(.58)
5 mos. under 6 mos.	355	64.39	7.00	.109(.61)
6 mos. under 7 mos.	363	67.12	7.54	.112(.63)
7 mos. under 8 mos.	351	68.58	7.97	.116(.65)
8 mos. under 9 mos.	378	69.35	8.19	.118(.66)
9 mos. under 10 mos.	321	70.23	8.34	.119(.66)
10 mos. under 11 mos.	393	71.40	8.61	.121(.68)
11 mos. under 12 mos.	369	72.03	8.77	.122(.68)
12 mos. under 13 mos.	348	73.15	9.17	.125(.70)

* English measure

contests. The data collected for the curve of Variot and Fliniaux (*3*) and reported to the Academy of Science at Paris 1914 represent the growth of breast-fed infants. Schmid-Monnard's (*4*) curve represents the growth of breast-fed children in Frankfurt am Main, 1891-92.

The figures upon which these charts were constructed are given in the comparatives tables for infants, Part V. The number of cases

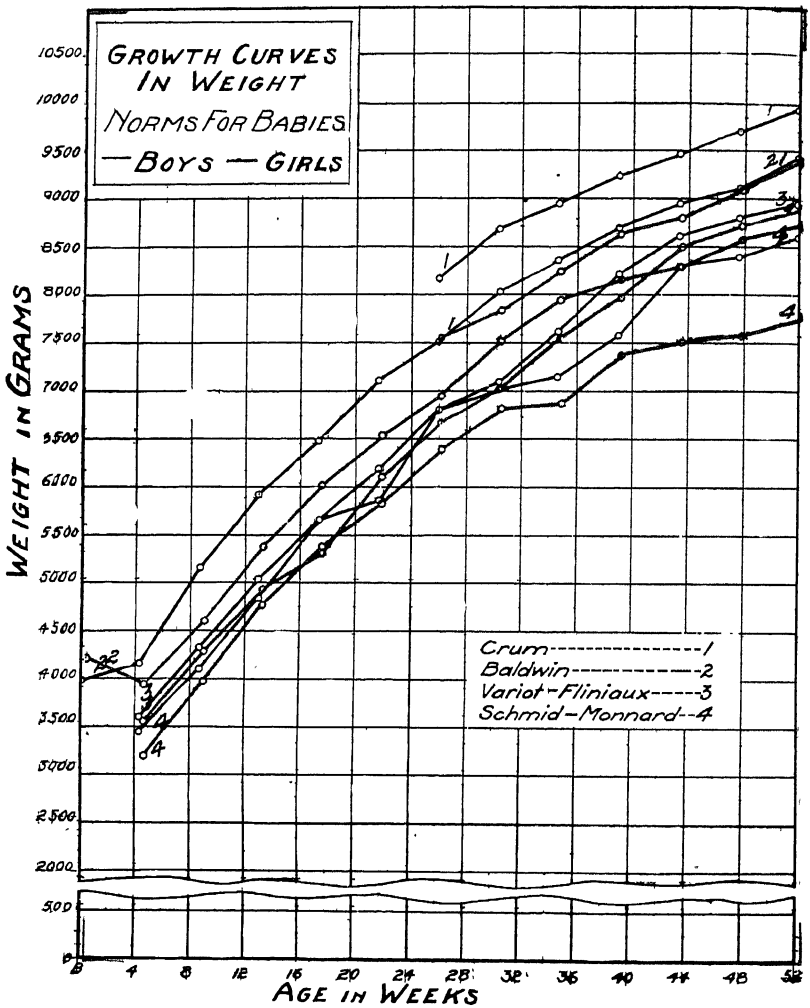

Chart VI

used to obtain the averages are given (when the investigator's own report includes them) in the footnotes to the comparative tables.

3. Growth Curves in Weight—Males and Females

Chart VI page 54 represents the weight of infants reported in the same investigations as those mentioned above for height, and the curves are numbered the same.

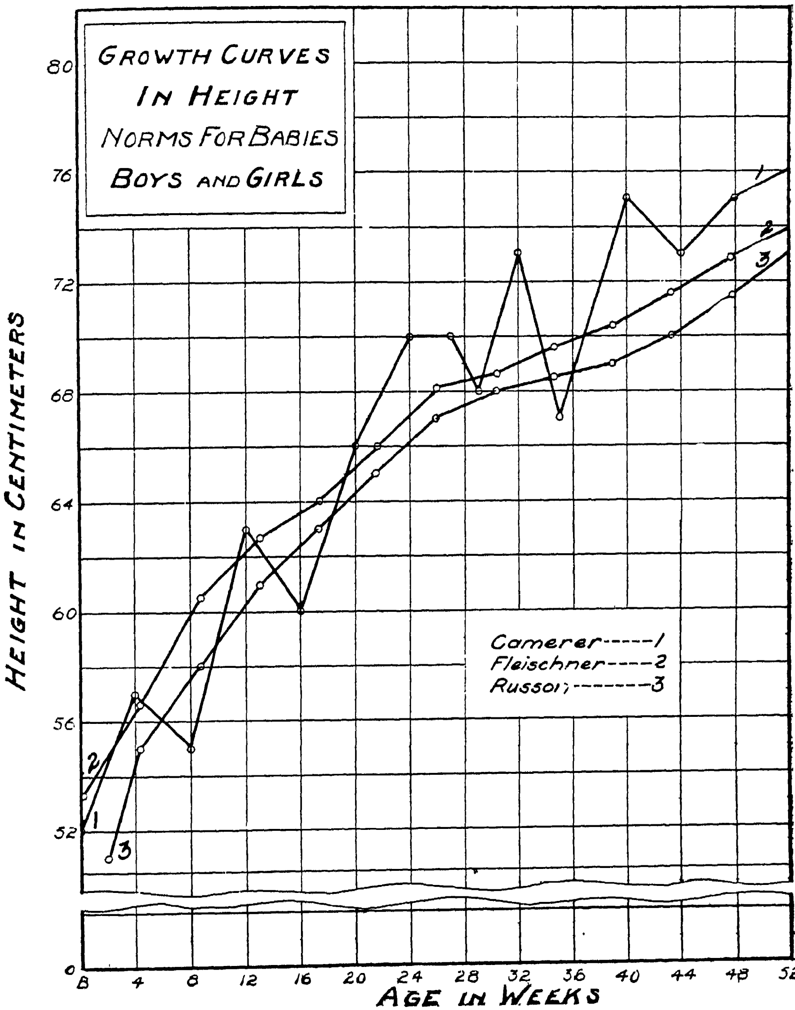

Chart VII

4. Growth Curves in Height—Males and Females Combined

Chart VII page 55 gives the height of infants according to three investigators who combined the measurements of boys and girls in obtaining an average. The figures for the curve of Fleischner (*2*) were computed from his table of increments for well-nourished American infants published in 1906. Camerer's (*1*) curve represents the height of breast-fed boys and girls

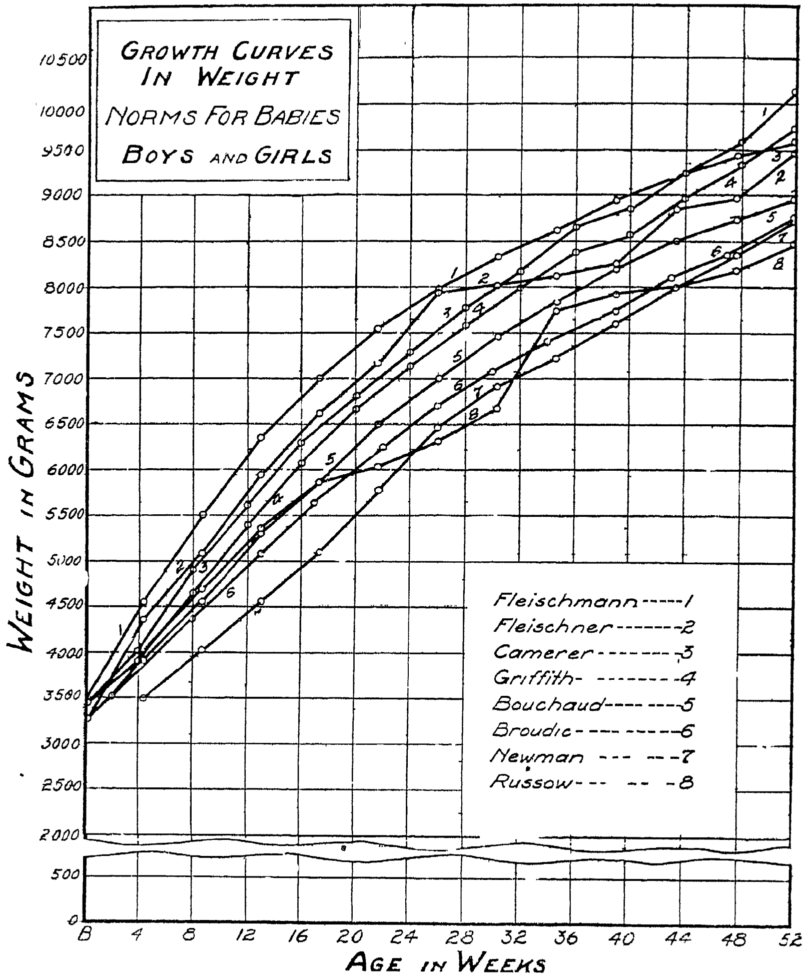

Chart VIII

(German). These data were published in 1901. The curve of Russow (*3*) also represents the height of breast-fed German infants. These figures were published in 1881.

5. Growth Curves in Weight—Males and Females Combined

In Chart VIII page 56 representing the weight of infants (sexes combined) these three investigators, Camerer (*3*), Fleischner (*2*) and Russow (*8*) are again represented, in addition to five others. The figures upon which the curve of Griffith (*4*) was constructed were estimated from a graph in his *Diseases of Infants and Children*. The actual measurements upon which his own graph was constructed seem never to have been published in table form. Presumably they represent the growth of American infants. The figures for Bouchaud's (*5*) curve for French infants were published in 1864. Broudic's (*6*) curve shows the growth of French infants (breast and bottle fed) according to measurements published in 1919. The figures upon which the curve for Newman (*7*) was drawn are quoted from Robertson who believes this Newman standard commonly used in England is really derived from French infants. The data of Fleischmann's (*1*) curve, obtained from German children, were published in 1877.

6. Conclusions

I. The Crum charts and tables, beginning at six months, for 2945 selected infants at baby contests are too high for norms for American children in general.

II. The curves of Baldwin and the Federal Children's Bureau for 9074 infants from birth to 12 months are the most satisfactory available normal standards for American children for height and weight. In weight they tend to drop below the best posited standard after six months.

III. French and German infants are inferior to American infants in height and weight during the first year of infancy.

IV. The growth curves of Fleischner, Camerer and Russow are not reliable as norms for height, since they do not take account of sex differences.

V. The combined weight curves of Camerer, Fleischner, Russow, Griffith, Bouchaud, Broudic, Newman, and Fleischmann are not reliable, since they do not differentiate between males and females.

CHAPTER IV

GROWTH OF PRE-SCHOOL CHILDREN

1. Methods of Collecting Data

Table X on page 60 gives the average height, weight, and weight-height indices of 36,958 boys and girls between the ages of birth and 72 months, from the 99 counties of Iowa. The measurements should be especially good, having in all cases been made on nude children by a physician of good standing or a graduate nurse. In the State of Iowa approximately 140,000 children were weighed and measured, but all except those of the approved class were eliminated, including those having any defect or disease which necessarily interferes with the growth and nutrition of the child. The original data were collected during the National Children's Year campaign from April to June, 1918, under the direction of the Federal Children's Bureau, the Child Welfare Research Station, the Women's Committee of the Council of National Defense, with the coöperation of the Federated Women's Clubs, Parent Teachers Association, Woman's Christian Temperance Union, and other agencies, in accordance with a general policy agreed upon at a conference at Fort Dodge, March 5th, 1918, at which the writer and Dr. Ellsworth Faris, who later became Acting Director during the war, were present. Iowa had the larger proportion of her children weighed and measured. The proportion of children included in the tabulation, *i. e.* those reported by physicians as weighed and measured without clothing, was larger in Iowa than in any other state, approximately 13 per cent of the estimated white population of Iowa under six years of age having been included in the tabulation. The public interest aroused during the collection of these data in each of the 99 counties of the State has resulted in a state-wide demand for permanent clinics, public health nurses, school physicians and child welfare stations.

Through the courtesy of the office of the Federal Children's Bureau the original cards from Iowa were tabulated and the averages furnished the writer, who, in turn, has transferred them

into the metric system, worked out the weight-height indices and constructed the charts on pages 63 to 64. The results furnish new and reliable standards of growth for pre-school children.

The tendency, which may be noted in Table X, for Iowa children to drop back proportionately in weight is due, no doubt, to several factors, including the lack of proper nutrition and medical inspection. That it is not due to the predominance of any particular foreign-born population may be gleaned from the nativity distribution of Iowa's total population in 1915. The 1920 census shows approximately the same distribution with a total population of 2,403,630.

Nativity group	Number	Percent
All nativities	2,358,066	100.0
Native white of native parents	1,422,464	60.3
Native white of foreign or mixed parentage	654,855	27.8
Foreign-born white	264,003	11.2
Germany, Austria, Bohemia, Hungary	106,905	4.5
British Isles and Canada	48,115	2.0
Denmark, Norway and Sweden	64,877	2.8
Holland	12,638	.5
Russia	9,869	.4
Other foreign	21,599	1.0
Colored	16,744	.7

The advance sheets of the tabulation from the Federal Bureau by Dr. Robert M. Woodbury show that in Iowa 82.2 per cent of the 37,033 children under seven years of age are of native parentage with 7.9 percent of both parents foreign-born in the same country, and 7.2 percent in different countries. In this study 296 of the children were of Italian parentage (relatively short people), 1043 Scandinavian parentage (relatively tall people), 975 of German parentage, and 217 of negro parentage. The latter group of 217 negroes was not included in the above table. The rural children it was found are slightly above the urban in height and weight for these ages from birth to six years, for both boys and girls. The Iowa children are slightly below the California children in height and weight, and decidedly above the New York children.

"The measurements of the Iowa children approximate those of the children in the country as a whole, with a slight excess, a fifth

of an inch, in stature. Children under one year of age are nearly three ounces heavier, but those one year or over are from one to three ounces lighter than the average for the country as a whole." (From the advance Report of the Federal Bureau.)

TABLE X

HEIGHT AND WEIGHT OF IOWA PRE-SCHOOL CHILDREN
18,770 Boys; 18,188 Girls; Total 36,958.
Age: From Birth to Six Years

BOYS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	29	52.38	4.00	.076(.43)*
Under 1 month	124	53.83	4.15	.077(.43)
1 month under 2 mos.	307	57.93	5.15	.089(.50)
2 mos. under 3 mos.	341	60.50	5.92	.098(.55)
3 mos. under 4 mos.	408	62.81	6.49	.103(.58)
4 mos. under 5 mos.	364	64.76	7.10	.110(.61)
5 mos. under 6 mos.	393	66.58	7.50	.113(.63)
6 mos. under 7 mos.	399	68.38	8.03	.117(.66)
7 mos. under 8 mos.	413	69.25	8.36	.121(.68)
8 mos. under 9 mos.	368	70.62	8.68	.123(.69)
9 mos. under 10 mos.	370	71.94	8.95	.124(.70)
10 mos. under 11 mos.	394	72.60	9.11	.125(.70)
11 mos. under 12 mos.	376	73.80	9.40	.127(.71)
12 mos. under 13 mos.	396	74.69	9.54	.128(.72)
13 mos. under 14 mos.	285	75.96	9.80	.129(.72)
14 mos. under 15 mos.	306	76.56	10.01	.131(.73)
15 mos. under 16 mos.	301	77.70	10.09	.130(.73)
16 mos. under 17 mos.	310	79.09	10.42	.132(.74)
17 mos. under 18 mos.	307	79.39	10.61	.134(.75)
18 mos. under 19 mos.	307	80.36	10.76	.134(.75)
19 mos. under 20 mos.	292	82.06	11.12	.136(.76)
20 mos. under 21 mos.	284	82.87	11.25	.136(.76)
21 mos. under 22 mos.	278	83.73	11.52	.138(.77)
22 mos. under 23 mos.	293	84.52	11.72	.139(.78)
23 mos. under 24 mos.	327	84.85	11.72	.138(.77)
24 mos. under 25 mos.	316	85.84	11.92	.139(.78)
25 mos. under 26 mos.	302	86.67	12.23	.141(.79)
26 mos. under 27 mos.	305	87.00	12.27	.141(.79)
27 mos. under 28 mos.	287	87.77	12.34	.141(.79)
28 mos. under 29 mos.	312	88.25	12.56	.142(.80)
29 mos. under 30 mos.	339	88.59	12.76	.144(.81)
30 mos. under 31 mos.	305	89.35	12.87	.144(.81)
31 mos. under 32 mos.	273	91.18	13.26	.145(.81)
32 mos. under 33 mos.	270	91.34	13.48	.148(.83)
33 mos. under 34 mos.	321	91.85	13.44	.146(.82)
34 mos. under 35 mos.	300	92.45	13.67	.148(.83)

35 mos. under 36 mos.	307	92.77	13.71	.148(.83)
36 mos. under 37 mos.	301	93.74	13.98	.149(.84)
37 mos. under 38 mos.	293	94.11	13.96	.148(.83)
38 mos. under 39 mos.	293	94.84	14.19	.150(.84)
39 mos. under 40 mos.	296	95.47	14.32	.150(.84)
40 mos. under 41 mos.	292	95.77	14.42	.151(.84)
41 mos. under 42 mos.	304	96.33	14.62	.152(.85)
42 mos. under 43 mos.	285	97.62	14.94	.153(.86)
43 mos. under 44 mos.	284	97.98	15.01	.153(.86)
44 mos. under 45 mos.	285	98.82	15.04	.152(.85)
45 mos. under 46 mos.	295	99.29	15.44	.156(.87)
46 mos. under 47 mos.	285	99.28	15.35	.155(.87)
47 mos. under 48 mos.	324	100.14	15.52	.155(.88)
48 mos. under 49 mos.	266	99.93	15.86	.159(.89)
49 mos. under 50 mos.	248	100.77	15.59	.155(.87)
50 mos. under 51 mos.	229	101.64	15.82	.156(.87)
51 mos. under 52 mos.	238	101.70	15.94	.157(.88)
52 mos. under 53 mos.	267	102.10	16.10	.158(.88)
53 mos, under 54 mos.	252	102.74	16.27	.158(.89)
54 mos. under 55 mos.	248	103.16	16.22	.157(.88)
55 mos. under 56 mos.	247	104.01	16.34	.157(.88)
56 mos. under 57 mos.	232	104.99	16.73	.159(.89)
57 mos. under 58 mos.	246	105.28	16.85	.160(.90)
58 mos. under 59 mos.	253	105.52	16.95	.161(.90)
59 mos. under 60 mos.	248	105.80	16.94	.160(.90)
60 mos. under 61 mos.	100	106.35	17.19	.162(.91)
61 mos. under 62 mos.	79	106.65	17.27	.163(.91)
62 mos. under 63 mos.	61	107.72	17.51	.163(.91)
63 mos. under 64 mos.	57	106.95	17.26	.161(.90)
64 mos. under 65 mos.	60	107.23	17.51	.163(.91)
65 mos. under 66 mos.	76	108.82	17.74	.163(.91)
66 mos. under 67 mos.	46	109.55	18.22	.166(.93)
67 mos. under 68 mos.	46	109.83	18.33	.167(.93)
68 mos. under 69 mos.	40	110.36	18.57	.168(.94)
69 mos. under 70 mos.	37	111.49	18.85	.169(.94)
70 mos. under 71 mos.	29	112.11	18.63	.166(.93)
71 mos. under 72 mos.	29	112.02	18.58	.166(.93)

GIRLS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	24	53.87	4.25	.079(.44)*
Under 1 month	95	53.34	3.98	.075(.42)
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5 mos. under 6 mos.	355	64.39	7.00	.109(.61)
6 mos. under 7 mos.	363	67.12	7.54	.112(.63)
7 mos. under 8 mos.	351	68.58	7.97	.116(.65)
8 mos. under 9 mos.	378	69.35	8.19	.118(.66)

9 mos. under 10 mos.	321	70.23	8.34	.119(.67)
10 mos. under 11 mos.	393	71.40	8.61	.121(.68)
11 mos. under 12 mos.	369	72.03	8.77	.122(.68)
12 mos. under 13 mos.	348	73.15	9.17	.125(.70)
13 mos. under 14 mos.	300	74.16	9.16	.124(.69)
14 mos. under 15 mos.	281	75.21	9.32	.124(.69)
15 mos. under 16 mos.	308	76.23	9.54	.125(.70)
16 mos. under 17 mos.	286	77.21	9.68	.125(.70)
17 mos. under 18 mos.	302	78.07	9.93	.127(.71)
18 mos. under 19 mos.	297	79.28	10.20	.129(.72)
19 mos. under 20 mos.	298	80.80	10.56	.131(.73)
20 mos. under 21 mos.	280	81.28	10.61	.131(.73)
21 mos. under 22 mos.	261	82.43	10.80	.131(.73)
22 mos. under 23 mos.	279	82.89	11.06	.133(.74)
23 mos. under 24 mos.	264	83.45	11.14	.133(.74)
24 mos. under 25 mos.	306	83.94	11.41	.136(.76)
25 mos. under 26 mos.	281	84.68	11.44	.135(.75)
26 mos. under 27 mos.	315	85.91	11.72	.136(.76)
27 mos. under 28 mos.	310	86.46	11.89	.138(.77)
28 mos. under 29 mos.	295	86.83	11.97	.138(.77)
29 mos. under 30 mos.	310	87.85	12.21	.139(.78)
30 mos. under 31 mos.	315	88.61	12.41	.140(.78)
31 mos. under 32 mos.	291	89.70	12.59	.140(.78)
32 mos. under 33 mos.	267	90.13	12.66	.140(.78)
33 mos. under 34 mos.	321	90.51	12.77	.141(.79)
34 mos. under 35 mos.	276	91.28	13.00	.142(.79)
35 mos. under 36 mos.	293	91.48	13.06	.143(.80)
36 mos. under 37 mos.	305	92.35	13.34	.144(.81)
37 mos. under 38 mos.	274	92.92	13.45	.145(.81)
38 mos. under 39 mos.	264	93.96	13.69	.146(.82)
39 mos. under 40 mos.	280	94.23	13.57	.144(.81)
40 mos. under 41 mos.	308	94.57	13.75	.145(.81)
41 mos. under 42 mos.	297	95.31	14.06	.148(.83)
42 mos. under 43 mos.	300	96.16	14.15	.147(.82)
43 mos. under 44 mos.	262	96.42	14.24	.148(.83)
44 mos. under 45 mos.	282	97.29	14.30	.147(.82)
45 mos. under 46 mos.	277	97.76	14.52	.149(.83)
46 mos. under 47 mos.	292	98.33	14.73	.150(.84)
47 mos. under 48 mos.	307	98.42	14.62	.149(.83)
48 mos. under 49 mos.	265	99.89	15.00	.150(.84)
49 mos. under 50 mos.	273	99.88	15.10	.151(.84)
50 mos. under 51 mos.	262	100.47	15.25	.152(.85)
51 mos. under 52 mos.	258	100.93	15.29	.151(.84)
52 mos. under 53 mos.	263	101.08	15.39	.152(.85)
53 mos. under 54 mos.	277	101.70	15.43	.152(.85)
54 mos. under 55 mos.	244	102.12	15.58	.153(.86)
55 mos. under 56 mos.	196	102.95	15.77	.153(.86)
56 mos. under 57 mos.	229	103.77	16.05	.155(.87)
57 mos. under 58 mos.	202	104.25	16.01	.154(.86)
58 mos. under 59 mos.	232	105.13	16.47	.157(.88)
59 mos. under 60 mos.	248	105.13	16.37	.156(.87)
60 mos. under 61 mos.	93	105.31	16.54	.157(.88)

61 mos. under 62 mos.	56	105.95	16.94	.160(.89)
62 mos. under 63 mos.	64	105.49	16.65	.158(.88)
63 mos. under 64 mos.	70	106.39	16.61	.156(.87)
64 mos. under 65 mos.	64	107.16	17.08	.159(.89)
65 mos. under 66 mos.	62	107.38	17.07	.159(.89)
66 mos. under 67 mos.	50	106.99	17.48	.163(.91)
67 mos. under 68 mos.	47	108.30	17.54	.162(.91)
68 mos. under 69 mos.	42	108.74	18.16	.167(.93)
69 mos. under 70 mos.	36	110.84	18.27	.165(.92)
70 mos. under 71 mos.	33	110.30	17.91	.162(.91)
71 mos. under 72 mos.	41	109.73	18.14	.165(.92)

*English measure

2. Growth Curves in Weight and Height, Iowa Boys and Girls

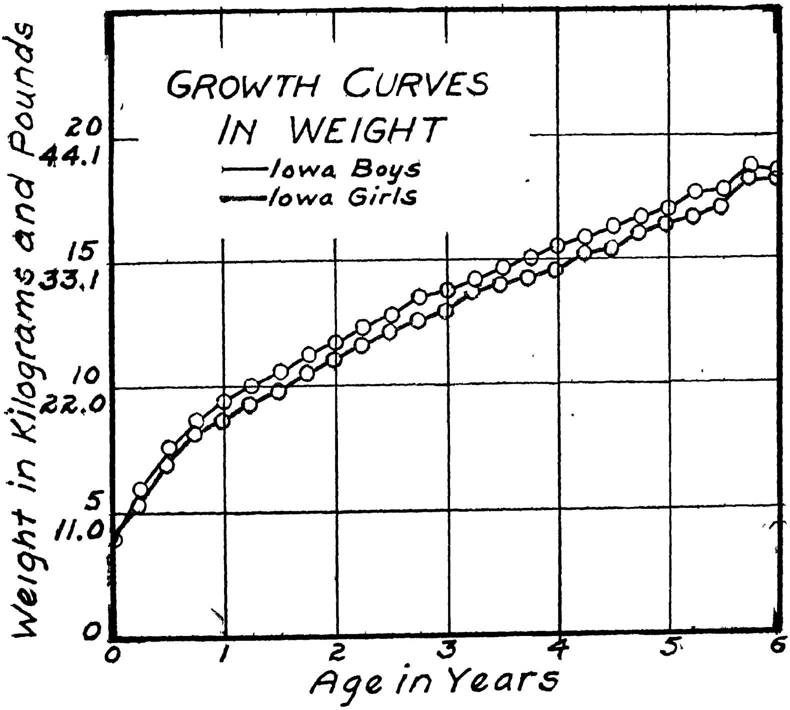


Chart IX

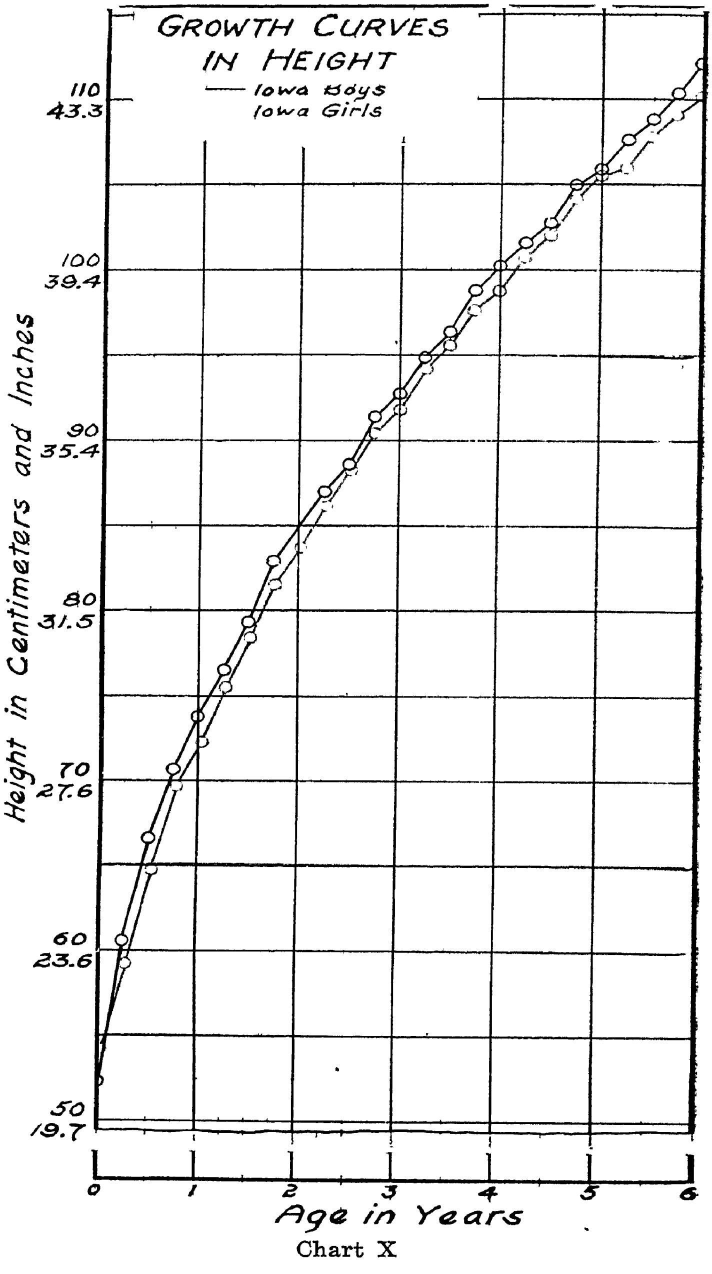

GROWTH CURVES
IN HEIGHT
Iowa Boys
Iowa Girls
Height in Centimeters and Inches
110
43.3
100
39.4
90
35.4
80
31.5
70
27.6
60
23.6
50
19.7
0
1
2
3
4
5
6
Age in Years

Chart X

3. Percent of Growth of Pre-School Children

On examining Table XI it will be noted that the height doubles during the first six years after birth and the weight increases four times. The greatest increase is during the first year in both height and weight. The weight-height index on an average doubles during the first six years after birth. The percent of gain is higher for boys than for girls at each age after birth and the weight-height indices are uniformly higher for boys than for girls.

Table XI

PERCENTS OF TOTAL STATURE AND WEIGHT AT SIX YEARS OF AGE

18,770 Iowa Boys and 18,188 Girls

Age	Sex	Height %	Weight %	Weight-Height Index
Birth	Boys	46.8	21.5	.076 (.42)*
	Girls	49.1	23.4	.079 (.44)
At 1 yr.	Boys	65.9	50.6	.127 (.71)
	Girls	65.6	48.3	.122 (.68)
At 2 yrs.	Boys	75.7	63.1	.138 (.77)
	Girls	76.1	61.4	.133 (.74)
At 3 yrs.	Boys	82.8	73.8	.148 (.83)
	Girls	83.4	72.0	.143 (.80)
At 4 yrs.	Boys	89.4	83.5	.155 (.87)
	Girls	89.7	80.6	.149 (.83)
At 5 yrs.	Boys	94.4	91.2	.160 (.89)
	Girls	95.8	90.2	.156 (.87)
At 6 yrs.	Boys	100.0	100.0	.166 (.93)
	Girls	100.0	100.0	.165 (.92)

* English measure

4. Individual Differences in Pre-School Children

From a clinical point of view, Table XII gives a synoptic picture of the physical measurements of nine boys and nine girls, rang-

TABLE XII

PHYSICAL MEASUREMENTS OF PRE-SCHOOL CHILDREN (IOWA CITY)

Cases	Age	Standing Height	Sitting Height	Diameter of Head		Circum-ference of Head	Width of Shoulders	Diameter of Chest		Circum-ference of Chest	Width of Hips	Length of right				Weight	Weight-height index
				Anterior-posterior	Trans-verse			Trans-verse	Anterior-posterior			Shoulder-elbow	Elbow-finger	Knee-table	Foot		
	BOYS																
1	4 mos.	64.5	43.0	15.7	12.4	40.9	19.9	14.2	13.3	44.4	14.3	12.6	18.7	17.7	8.4	7.94	.123(.69)*
2	8 mos.	67.5	44.3	15.2	12.4	42.2	18.0	13.7	12.8	44.5	14.0	13.6	17.8	18.4	9.5	7.39	.109(.61)
3	13 mos.	79.5	50.0	15.8	13.9	46.8	22.8	17.1	14.7	54.4	17.0	15.4	22.6	22.0	11.5	11.5	.145(.81)
4	19 mos.	83.5	49.5	16.3	14.4	48.3	24.8	18.6	15.6	54.6	18.5	18.3	23.0	24.6	11.4	13.84	.166(.93)
5	2 yrs.	90.2	51.8	16.1	14.0	49.0	21.1	16.1	13.6	50.0	16.5	18.9	21.2	26.2	14.4	13.38	.148(.83)
6	2½ yrs.	90.9	53.3	17.5	14.6	50.2	24.1	17.0	14.5	52.0	18.1	20.2	25.0	26.4	13.9	14.83	.163(.91)
7	3 yrs.	99.1	57.2	18.5	13.7	51.8	22.4	17.0	13.7	50.8	17.3	19.6	26.7	28.5	15.5	14.78	.149(.83)
8	4 yrs.	105.4	60.0	16.6	13.8	47.9	25.2	18.2	14.4	57.0	20.2	21.3	27.6	30.9	16.9	17.14	.163(.91)
9	5 yrs.	115.0	63.3	17.8	14.0	51.4	28.5	19.5	15.9	61.0	22.0	25.8	31.3	34.4	18.3	23.13	.201(1.12)
	GIRLS																
1	4 mos.	67.1	45.3	14.0	11.4	42.2	19.6	15.2	13.9	47.5	14.7	12.5	17.3	18.0	9.8	7.26	.108(.60)
2	7 mos.	67.8	44.6	15.2	11.9	42.9	18.7	13.4	13.0	45.9	14.5	12.7	19.2	17.9	10.3	8.43	.124(.69)
3	10 mos.	71.2	44.7	15.3	12.6	43.0	19.2	15.9	12.0	46.0	16.5	14.3	20.3	19.8	10.2	8.62	.121(.68)
4	19 mos.	78.0	48.6	16.4	13.5	42.2	20.8	16.6	14.3	49.0	17.2	16.3	19.6	21.8	9.5	9.76	.125(.70)
5	2 yrs.	81.3	47.2	15.7	13.1	46.0	20.8	16.5	11.7	47.0	16.8	16.0	21.6	23.4	12.2	10.6	.130(.73)
6	2½ yrs.	91.3	54.7	17.7	14.5	51.4	23.4	17.0	13.1	54.6	18.4	18.8	24.0	24.9	14.6	15.2	.166(.93)
7	3¼ yrs.	93.0	53.3	17.4	13.7	49.5	21.3	17.0	12.2	50.2	18.0	18.7	24.8	27.4	14.0	13.2	.142(.79)
8	4 yrs.	101.0	57.0	18.2	14.8	40.6	26.4	19.5	15.5	59.2	21.8	26.2	27.8	26.8	13.9	19.1	.189(1.06)
9	4¾ yrs.	101.1	53.1	18.0	16.5	50.8	24.1	17.0	12.4	52.1	18.5	20.6	26.9	30.0	15.7	15.9	.157(.88)

* English measure.

ing in ages from four months to five years. The children were nude and the measurements were carefully made at the out clinic

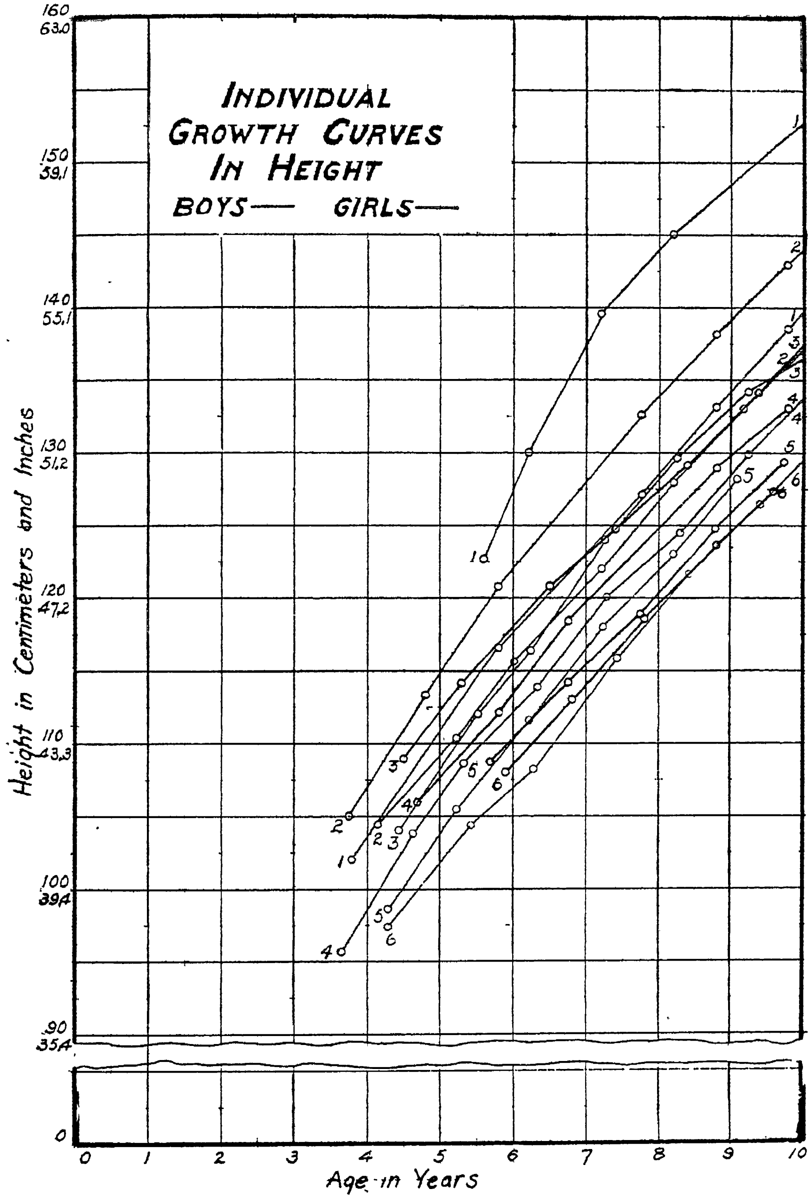


Chart XI

of the Research Station in Iowa City. A wide range of individual relationships will be noted. For example, the last girl particularly is low in sitting height, with small chest measurements when compared with the others; in head measurements the eighth boy is small; in width of shoulders, chest measurements, and width of

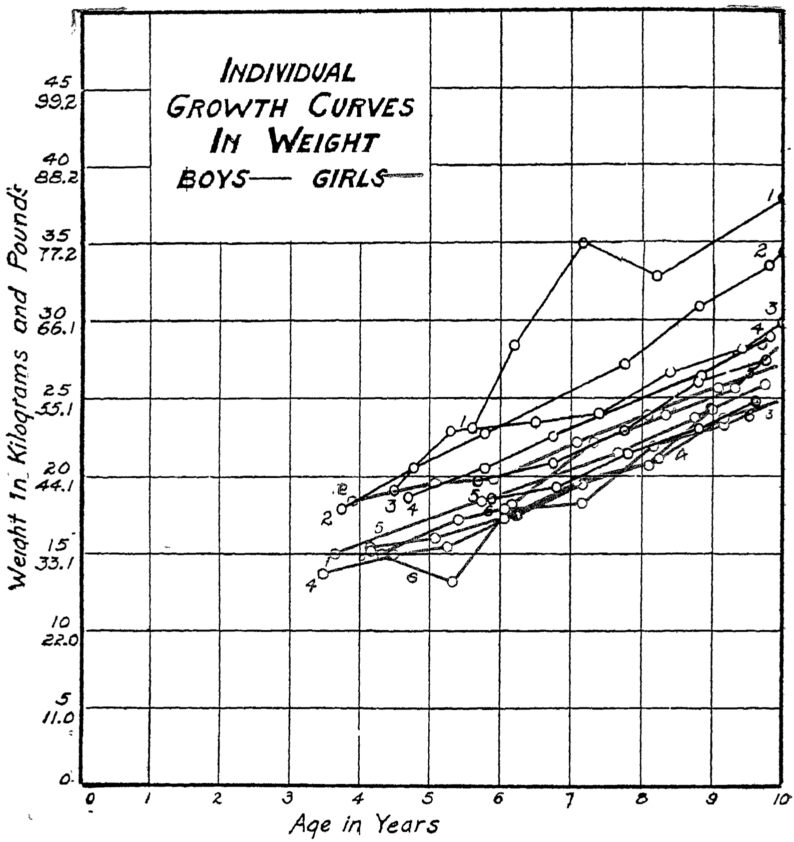


Chart XII

hips, the seventh boy and girl are comparatively small. This is also true for these two children in the other measurements and in weight.

These children were not selected as normal standards but taken at random to indicate the types of children that come to the out-clinic. Most of them had minor physical defects, but the parents were interested in getting physical ratings at regular intervals in order to improve the physical development of the children when possible.

Since few cases were recorded at birth, the averages for the first month are not very reliable but approach a good norm.

From the second month to the seventy-second month, the results are significant.

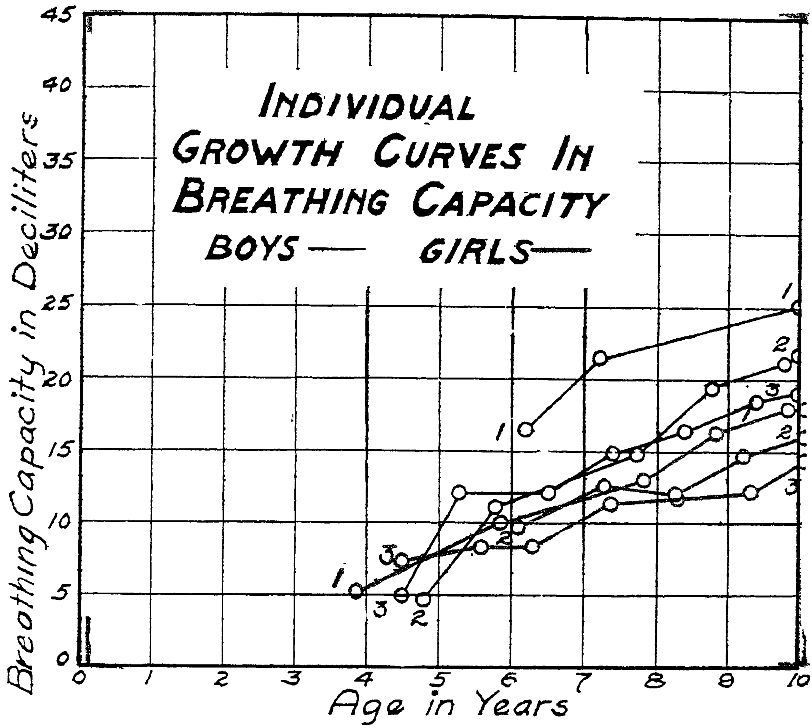


Chart XIII

5. Individual Growth Curves

These curves represent a series of repeated measurements on the same children.

6. Conclusions

I. It will be noted that the boys from birth to six years of age are uniformly taller and heavier at all ages than the girls.

II. For both boys and girls for this period the greatest increment and the greatest percent of growth is during the first year.

III. The percents of total stature and weight at six years of age show that the height doubles during the first six years after birth and the weight increases four times. The greatest increase

is during the first year in both height and weight. The weight-height index on an average, doubles during the first six years after birth.

IV. The most useful and instructive norms for these children from birth to six years of age are the weight-height indices. The indices are higher for the boys than the girls, ranging from .076

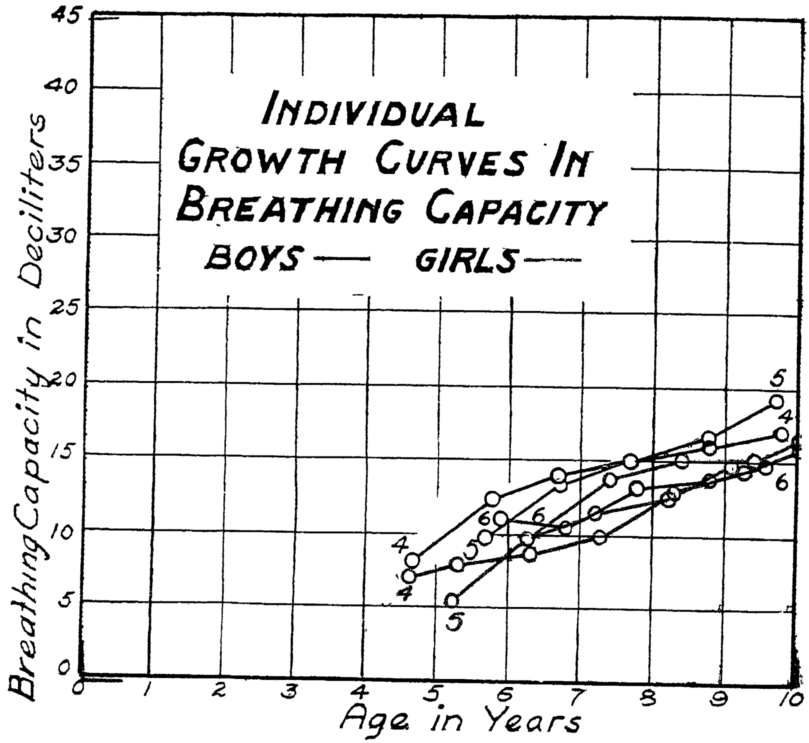


Chart XIII

and .079 respectively for the first month, to .166 and .165 for the seventy-second month. It is apparent that the boys are relatively heavier for their height than the girls.

V. The most significant conclusion for Iowa lies in the fact that these boys and girls who are above the average of the United States in height begin soon after birth to lose weight in proportion to their height. This is probably a nutritional and health education problem. This is more evident as the ages increase.

VI. Of the Iowa children included in this *Study* 82 percent are native born.

VII. "The rural Iowa children from birth to six years of age are above the urban Iowa children in stature and weight."

VIII. The type-case pictures show the wide range of individual differences in the various physical traits among supposedly normal children for periods from four months to six years of age and the need for remedial and developmental training for all.

IX. The individual growth curves for pre-school children show significant but unexplained fluctuations at five or six years of age in individual growth curves in height, weight and breathing capacity.

CHAPTER V

PHYSICAL GROWTH OF SCHOOL CHILDREN

1. Data and Methods of Tabulation

The 400 individual growth curves given in Charts XIV to XLIV are representative and may be used as typical growth histories for children between six and 17 years of age. They are new but similar in appearance to the growth curves for the 170 individuals in height, in weight and in breathing capacity published in 1914 in *Physical Growth and School Progress* (27) and include in addition to these traits individual growth records of sitting height, chest girth, strength of right and left arms and strength of upper back.

The method of selection of individuals for the height curves consisted simply of taking a few tall and a few short children in order to get a fairly wide distribution over the chart, using the same individuals for weight, breathing capacity, etc., regardless of the distribution. The Arabic numbers refer to the same individuals. For example, No. 2 in all charts refers to the same individual, the black numeral referring to a boy and the red to a girl. The boys' individual curves are printed in black and the girls' in red, in order that a direct comparison between the two may be made. All charts are accurately constructed on "No. 3297 Sphinx Cross Section millimeter paper."

It will be apparent that the direction of the curves shows the absolute increase, decrease or uniformity of the increment of growth from period to period, the ordinates indicating yearly intervals and the small circles indicating the exact date of measurement. Straight lines of uniform pitch indicate equal increments of growth for the same individual. A change in the direction of the line at any circle or point of measurement indicates an increase or decrease in the increment if the line turns towards the vertical or towards the horizontal direction, respectively. These charts, like most growth curve charts, show graphically the absolute increments of growth and not the percentage of increase or decrease over the initial measurement. Baldwin (27) p. 39.

A. INDIVIDUAL CURVES, SET 1

(1) *Height, Boys. Girls.* It will be noted from a general survey of the two groups of curves that the boys are, as a rule, taller than

the girls, except from approximately 12 to 13 years of age, on the average. The girls reach their maximum period of growth earlier than the boys. With both groups there is a tendency for the curves to fan out as the age increases. In both the boys' and girls' curves there is a slight adolescent acceleration which appears earlier for the girls than for the boys, with a slight retardation before this pubescent acceleration. For both boys and girls at the pre-adolescent period, the pubescent acceleration causes the curves to approximate in appearance a series of concentric arcs of varying sizes, where a chronological point, say 12 years, in the lower arcs, is reached later than a corresponding point in the upper arcs. The taller boys and taller girls both reach their periods of maximum growth and periods of diminution of growth earlier than do the shorter boys and girls; this is more apparent with the girls than with the boys in this particular chart. In cases where there are periods of retardation during early adolescence, this is usually followed by a period of rapid acceleration during adolescence. If the increment of growth before adolescence is relatively uniform, this uniformity tends to persist throughout adolescence, resulting in some instances in growth curves in height becoming practically a straight line.

With both boys and girls the curves assume a railroad appearance; each individual boy and girl holds approximately his or her relative position in the group for the periods from six to 17 years of age, with little crossing of the individual curves. (This explains in graphic form the high correlations found between the heights at different ages for the same individual child, p. 140) In the 1914 bulletin, it was discovered that the increment of growth in height is comparatively uniform for each individual, so that the growth curves enable one to prophesy with a high degree of accuracy how tall a child of normal growth will be in the subsequent age, providing his or her relation to a given median or norm is known. In brief, tall children do not become short; neither do short children, as a rule, become tall under normal conditions. This discovery has been verified again with these new data.

(2) *Weight, Boys. Girls.* The individual weight curves in Chart XV are for the same group of individuals whose height curves are given in Chart XIV. It will be noted that there are strikingly significant differences between the growth in weight and the growth in height. The trend of the weight curves is toward concavity

rather than toward convexity. There is more individual variation in weight and more variation in the distribution of individuals within the group, although as a general rule heavy children remain

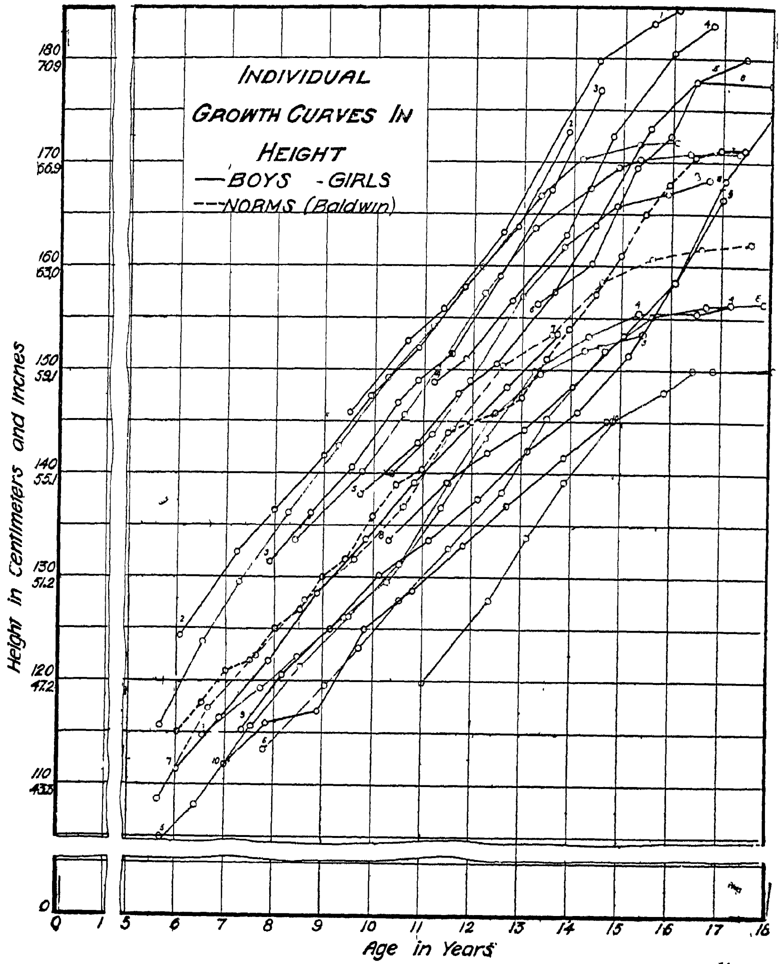


Chart XIV

relatively heavy during the period studied. Unlike height, weight may exceed or fall below the previous measurement—a fact that shows the urgent need of vigilance and the value of consecutive examinations on the part of school authorities.

Girls, as a rule, are relatively heavier for their height than boys,

and therefore the weight-height indices are higher for girls than for boys. The individual weight curves show that the pre-adolescent acceleration in weight precedes, as a rule, the acceleration in height,

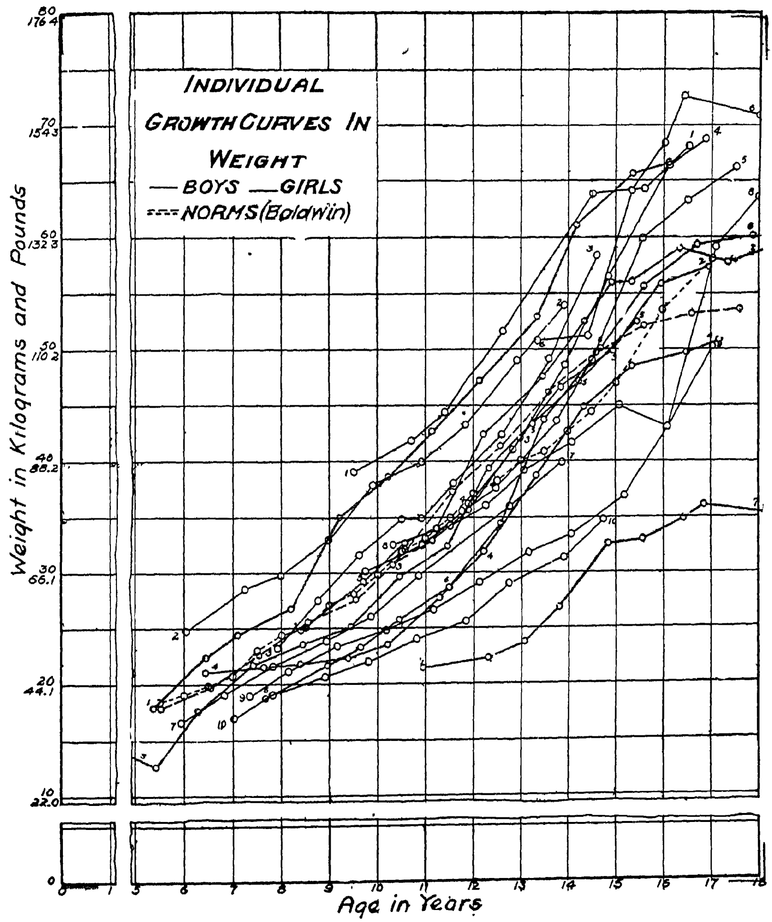


Chart XV

and that this stage in development is earlier for tall boys and tall girls.

(3) *Sitting Height, Boys. Girls.* For this group of American children it is apparent that there is a very close relationship between standing and sitting height for the same individual, since the distribution of the curves for height sitting is almost identical with the

distribution of the curves for height standing, though the relationship decreases slightly with age. The general trend of the curves is also very similar. These conditions are true, in general, for both boys and girls, but the relationship is closer for boys than for girls. The general conclusions outlined for standing height apply also to sitting height and there seem to be no marked differences between the relationship of the two for tall boys and girls and short boys

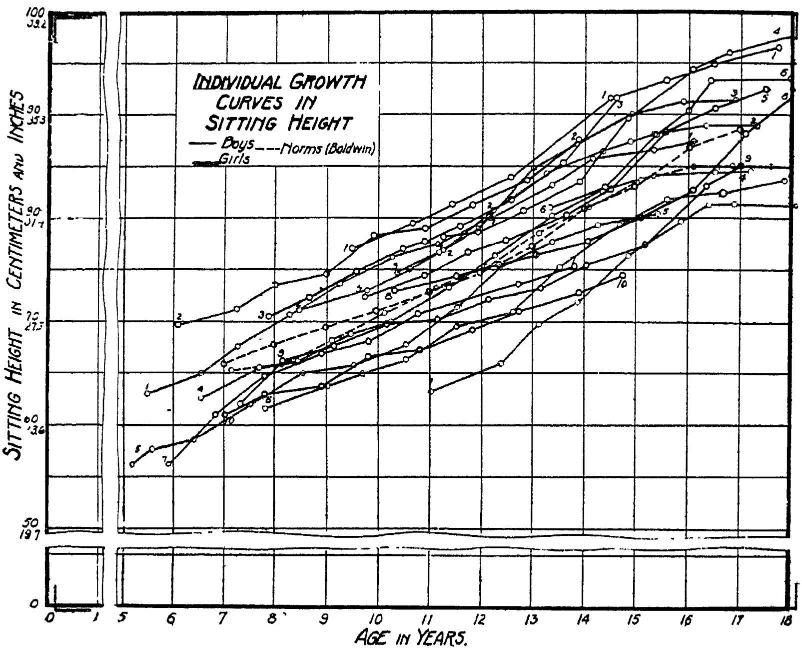


Chart XVI

and girls. There are, however, some interesting variations in the sitting height of children of the same stature, even in the same family. Sometimes the sitting height is indicative of definite racial characteristics, as for example the short trunk and long legs of the average American and the reverse condition in those of French descent. The boys and girls of tall sitting height as a rule have good or superior breathing capacity. The sitting height to the notch of the manubrium is probably a better standard for growth than the usual standing height, since the length of the neck and the size of the head are eliminated.

4. *Chest Girth, Boys. Girls.* An approximately close relation-

ship exists between the distribution of individual growth curves for chest circumference and height, but the relationship between breathing capacity and chest girth is not so close as has been generally assumed, though on the whole the general trend and positions of the two curves for each individual are similar. How far one should be taken as an equivalent of the other is an important question; the difference is more marked with girls than with boys.

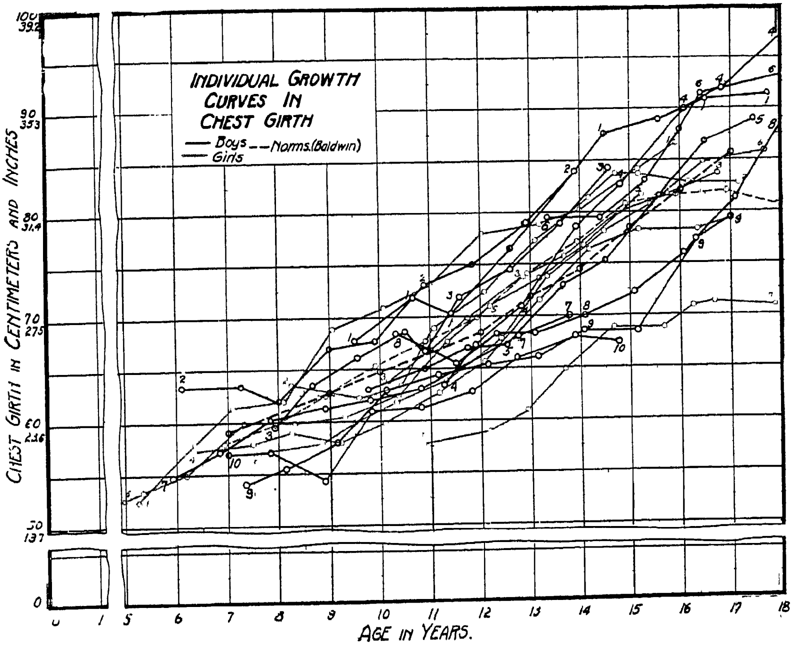
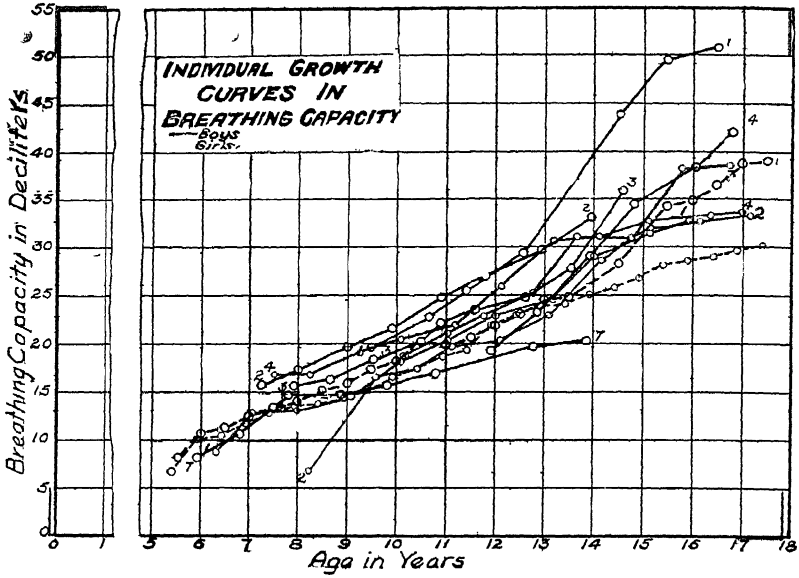


Chart XVII

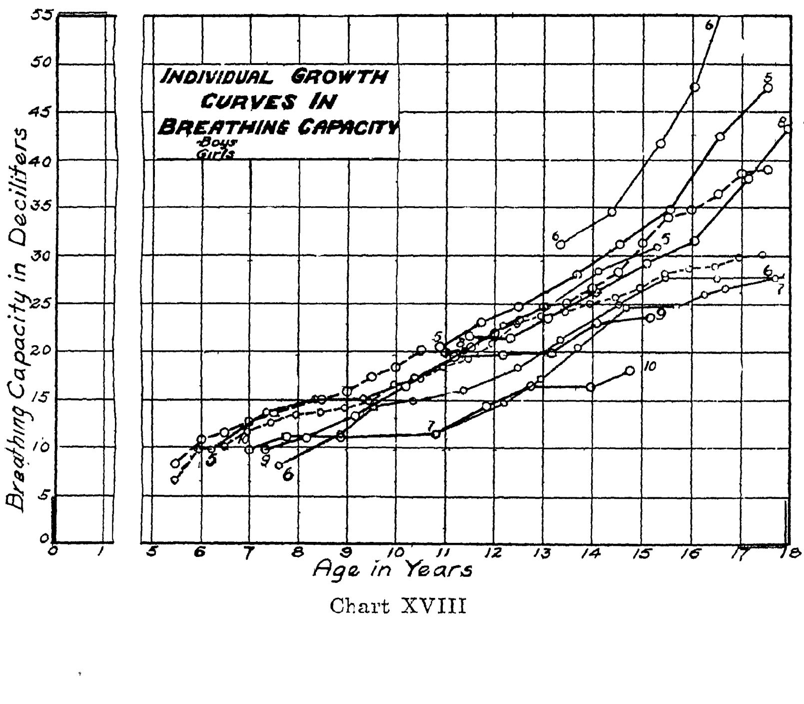
Although the so-called "normal" chest girth has been selected, the chest girth is affected by breathing, the curves showing fluctuations which are probably due in part to the difficulty of making accurate measurements of the amount of residual air in the lungs or the change in subcutaneous fat or muscle.

The chest girth of girls is relatively less than that of the boys except at adolescence, and there is a cessation of development considerably earlier than in the case of the boys.

(5) *Breathing Capacity, Boys. Girls.* The individual growth curves for the 17 individuals whose height curves are given in Chart XIV and whose weight curves are given in Chart XV are distrib-



INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years



INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

Chart XVIII

uted in Chart XVIII which has been divided into two sections, in order to avoid the confusion of overlapping curves, since the range of distribution for individuals at a given age is less than for height and weight. These measurements and those that follow in subsequent charts for this group of individuals differ essentially from the physical anthropometric measurements for height and weight where the measurements are objective and the mental attitude and voluntary effort of the subject have little or no influence. These latter measurements involve a decided mental factor and are frequently referred to as psycho-physical measurements, the psychical factor introducing a variable difficult to standardize, especially with young children.

These curves, like those of weight, tend toward concavity. There are more individual variations than for height and in general, the larger children have greater breathing capacity than the smaller ones. As in the case of weight, these measurements may fall below previous records, and the elements of training and exercise play important parts.

The girls as a group show a smaller breathing capacity than do the boys. The girls reach their periods of cessation of growth before the boys. The boys' curves show more concavity during the pre-adolescent age than do those of girls, and the general shape of the curves differs. When the large number of possibilities is considered, the curves of breathing capacity show relatively little crossing.

(6) *Strength of Arms and Upper Back, Boys. Girls.* The general trend of the curves of strength of right and left forearms are plotted. They are similar to the previous strength and breathing capacity curves with similar individual distribution, overlapping and marked fluctuations in increments of improvement or regression. The relationship between strength of right and left forearms with growth in height is less than that between growth in height and any of the other traits. The girls are not so strong as the boys, and the improvement tends to decrease after fifteen years of age. The right arm is stronger, as a rule, for both boys and girls, but the difference is not so marked as has usually been assumed by writers.

The range of distribution for individuals at a given chronological age, as in breathing capacity, is close, and therefore the curves displayed for the group of boys and girls have been placed in two charts, but the Arabic numerals still refer to the same individuals.

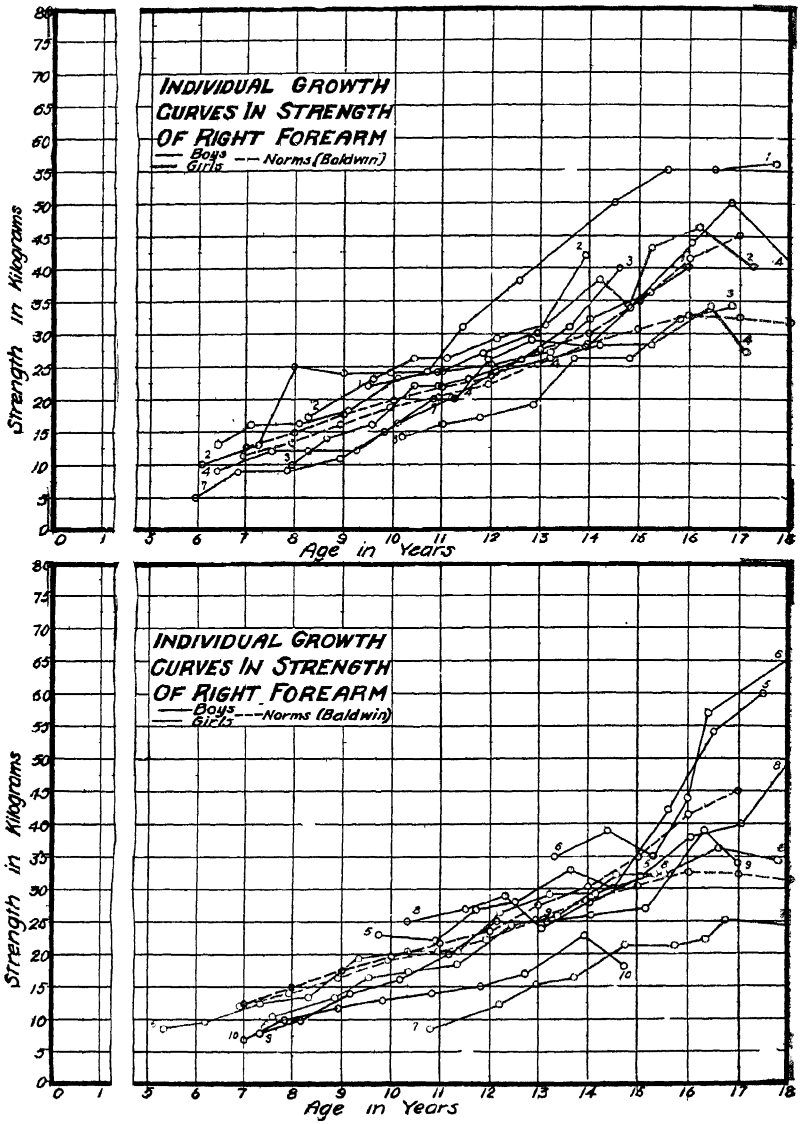


Chart XIX

As in the breathing capacity curves, the element of voluntary effort plays an important role here, and there are marked fluctuations which are, no doubt, due to this factor. In general distribu-

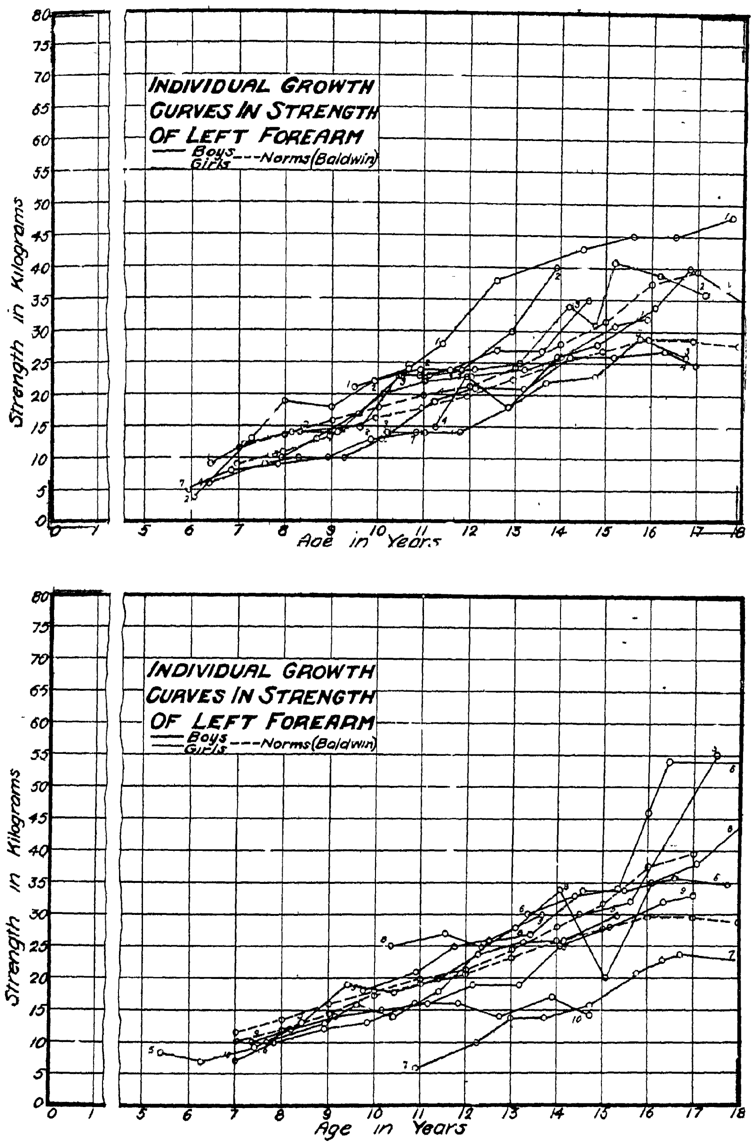


Chart XX

tion, these curves are not so closely related to those of height as in the case of the previous traits studied and consequently there is

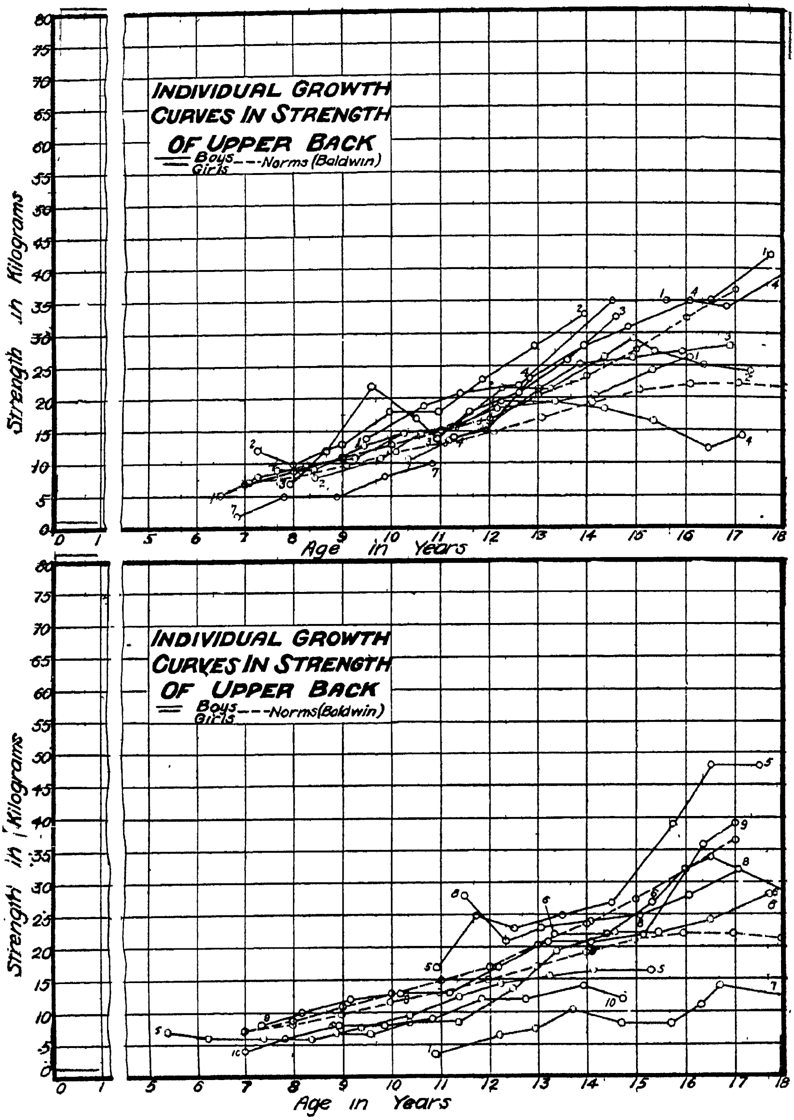


Chart XXI

more overlapping and a shifting of positions. On the whole, there is a gradual increase in the strength of the upper back from six to 18 years of age, similar to the increase in breathing capacity.

These girls are decidedly inferior to the boys in strength of the upper back, measured in kilograms. There is little increase and frequently a decrease in strength after 15 years of age for girls.

B. INDIVIDUAL CURVES, SET 2

(1) *Height.* (a) *Boys.* In this group of four boys selected at random from a group of about 200 with careful disease histories included, the first boy (*1*) shows a remarkably uniform growth curve in height from six to 17 years of age; at six he is 120 cms. tall, which is decidedly above the average of the larger group and at 17 he is 183.3 cms., which is also decidedly above the norm. No serious illness occurred, but he had weak feet and slightly enlarged tonsils from 10 to 13 years of age.

The second boy's (*2*) height curve is similar to (*1*), though he is shorter until 14 years of age, when he becomes retarded. His history is one of disease and other physical difficulties. He has had, during the school period, diphtheria twice, chicken pox, scarlet fever, tonsilitis, heart trouble, scarlet fever again, bad teeth, poor eye sight, poor posture and flat feet.

The third boy (*3*) also has a disease history of bronchitis and chicken pox, and enlarged tonsils, but these apparently affect growth in height but little. His poor posture during early school life was corrected somewhat during the later period as indicated by his health history. The latter period shows a regaining of the earlier relative position in height.

The fourth boy (*4*) was relatively small in stature at eight years of age and still much smaller relatively at 18 years of age. He had measles and chicken pox, and was also a mouth breather early in his school life. The nasal obstruction, enlarged tonsils and adenoids were not removed as advised, prior to twelve years of age. He had bad posture and poor eyesight, wearing glasses after 13 years of age. He is not so tall at 18 as his early height curve would lead one to expect. His growth has been stunted in height and it will be interesting to see how he measures up in other traits.

(b). *Girls.* The four girls in this group show more irregularity in growth in height than do the boys, particularly at a later age in the case of No. (*1*) and No. (*4*). No. (*1*) is a relatively tall girl until 13, but grows little after this age and very little after 14. She has had eye trouble, slightly enlarged tonsils, heart murmurs, and poor posture. She matured before 13 years of age.

No. (2) had slightly enlarged tonsils, a little heart trouble and was slightly nervous. Her growth curve is typical of good growth; she matured between 13 and 14 years of age. No. (3) had medium nutrition, but had adenoids removed at 14 years of age and also had

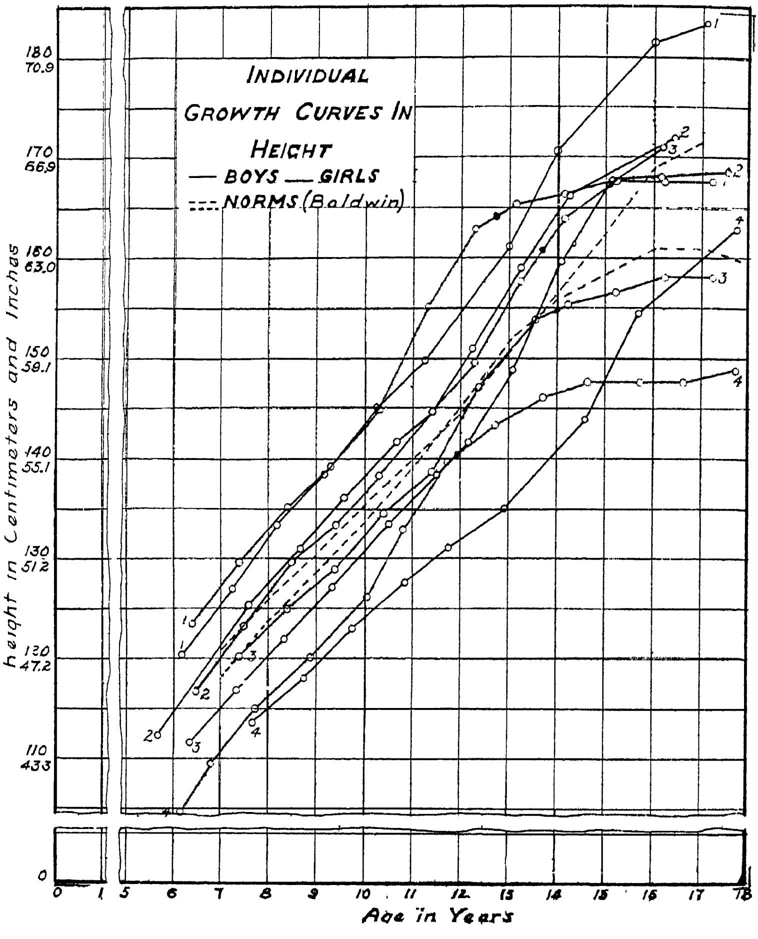


Chart XXII

a mastoid at this age. She matured during the same period. No. (4) had the usual children's diseases and enlarged tonsils which were not removed. The time of maturation was remarkably early for such a short girl, before 12 years, and cessation in growth began shortly after 12. A weak back is indicated.

(2) *Weight.* (a). *Boys.* The weight curves for these four boys are somewhat different from what would ordinarily be expected. The weight curve of No. (*1*) is very regular and uniform, but (*2*) and (*3*) are both superior to (*1*) at 16 years of age in spite of (*1*)'s

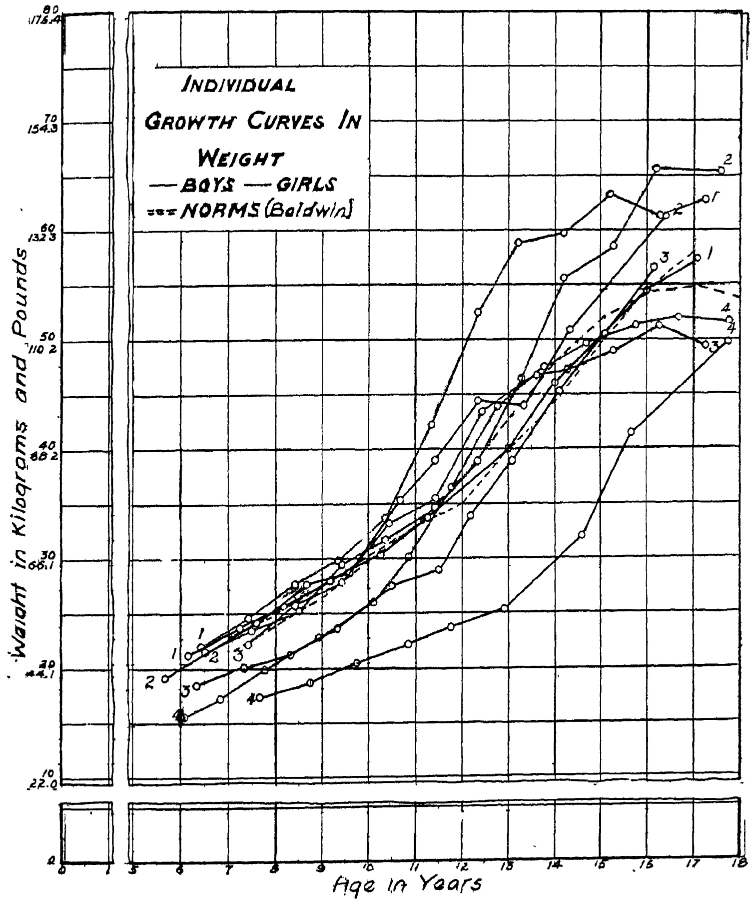


Chart XXIII

superior height. He is a tall, thin boy, weighing less than 60 kgs. at 17 years of age.

No. (*2*), regardless of his serious diseases, which gave him temporary setbacks, is a fairly heavy boy. No. (*3*), after his early illness with bronchitis and chicken pox, gained rapidly and consist-

ently after 11 years of age and excels No. (*1*) at 16. No. (*4*)'s weight curve, like his height curve, shows defective growth.

(b). *Girls.* In weight the growth curves are similar to those of height. (*1*) failed to gain after 13 as she should; (*2*) was more nearly normal in development; (*3*) lost in weight relatively after 13; and (*4*) had the same experience after 12 years of age.

(3) *Sitting Height.* (a) *Boys.* For height sitting, little need be

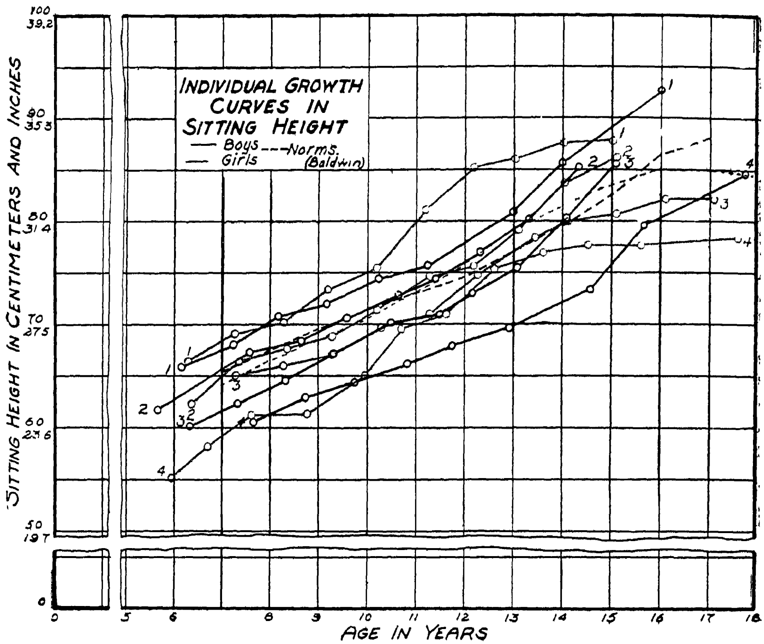


Chart XXIV

stated here, since the curves are so similar to those for height standing, but it should be noted that the same retardation is apparent for (*4*) as in height standing.

(b). *Girls.* In sitting height (*1*)'s records are incomplete after 15, but the trend until this time is similar to that in standing height, as is also the case with (*2*); both grow proportionately about the same in sitting height, *i. e.* the course of the curves is parallel. (*3*)'s curve trend is about the same as in height standing, and (*4*) fluctuates a little more, but ends in about the same position.

(4) *Chest Girth.* (a) *Boys.* In chest girth the thin, undeveloped nature of No. (*1*) is more apparent than in weight. No. (*2*)'s

robustness is shown by the ascending curve and No. (*3*) gains rapidly after 11½ years of age. No. (*4*) is still the smaller and relatively the inferior child.

(b). *Girls.* In development in girth of chest the story is different. All fluctuate considerably. (*3*) is inferior after 12 years of age; (*4*) exceeds (*1*) and equals (*2*) at 17½ years of age. It is apparent that there are other factors involved here than development of

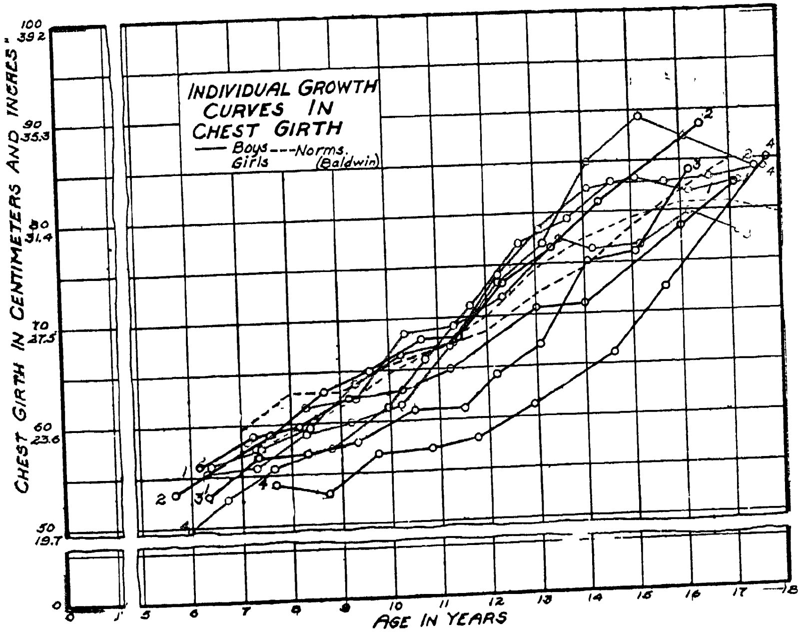


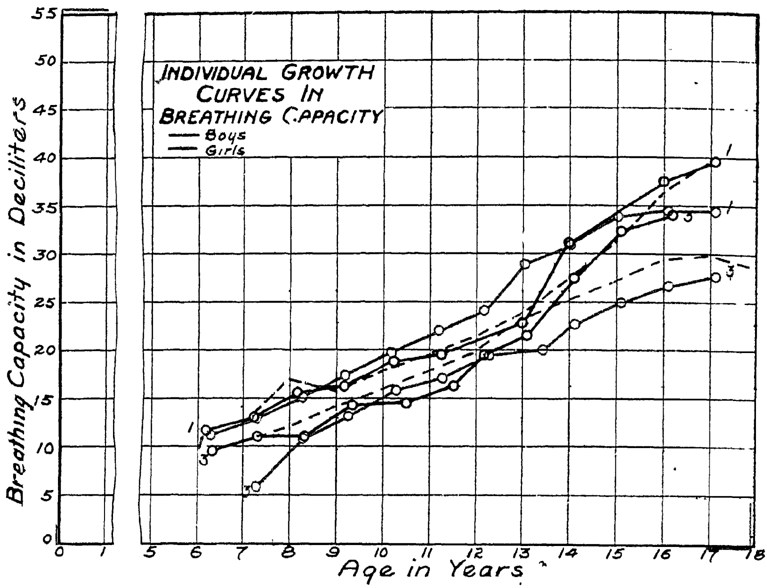
Chart XXV

breathing capacity; the early maturing of (*4*) is apparently one of these factors.

(5) *Breathing Capacity.* (a) *Boys.* In breathing capacity the boys have the same relative positions they had in height (*1*), (*2*), (*3*), (*4*), with individual fluctuations.

(b). *Girls.* The girls vary more individually in relative position, (*2*) and (*4*) having superior breathing capacity.

(6) *Strength of Arms and Upper Back.* (a) *Boys.* In strength of right forearm (*2*) still holds supremacy. He is strong, but relatively weak when his height is taken into consideration. No. (*3*) shows relative gains after 11½ years of age. The fourth boy


INDIVIDUAL GROWTH
CURVES IN
BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years
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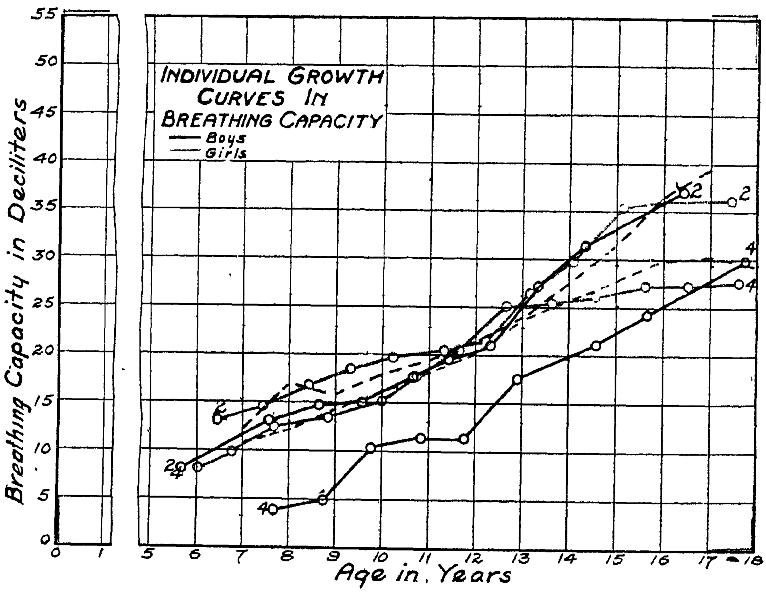
INDIVIDUAL GROWTH
CURVES IN
BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years
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Chart XXVI

(*4*) does not gain in strength as he should, when measured by a a norm, but the retarded growth in his other traits previously shown makes a further explanation unnecessary here.

No. (*1*) shows decided inferiority in strength of the left forearm,

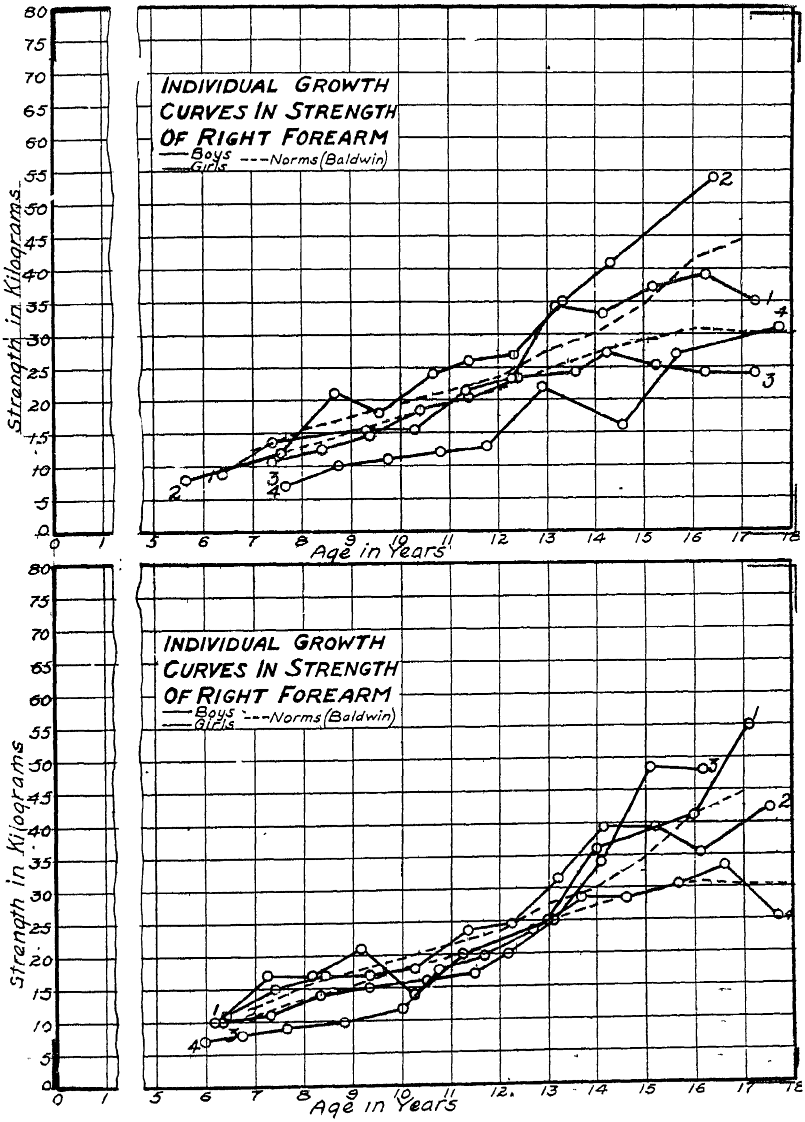
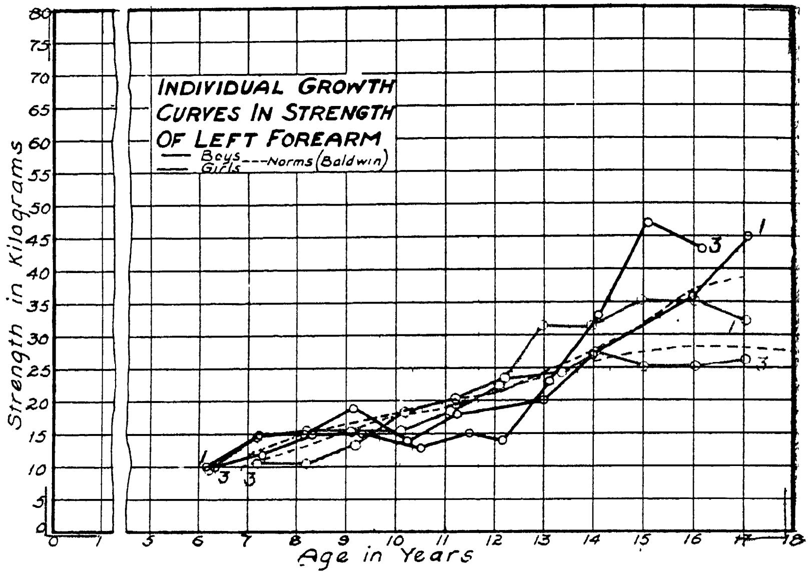


Chart XXVII

compared to that of the right. No. (2) is equally strong in both. No. (3) shows a similar equality, and No. (4) has about the same



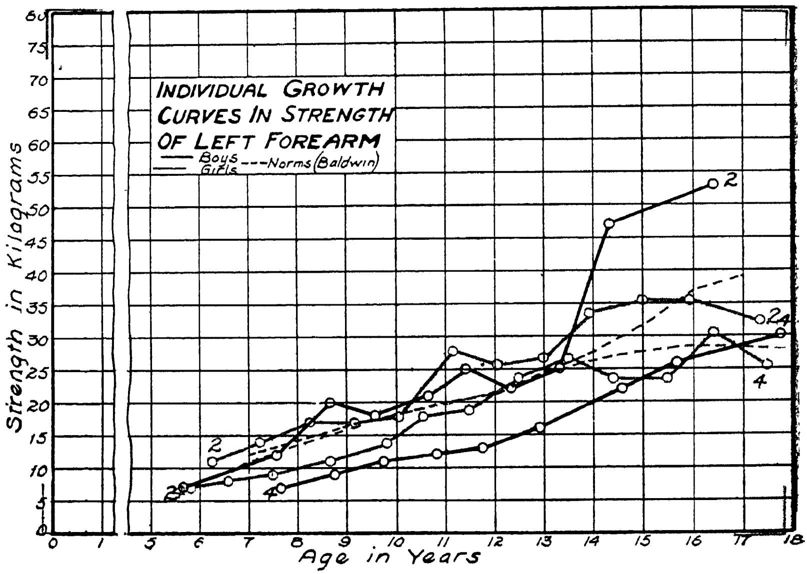
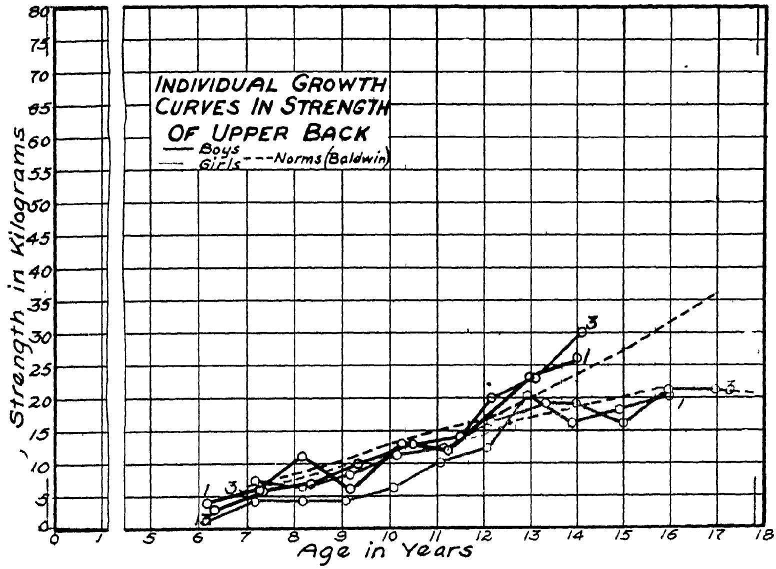


Chart XXVIII

strength in both forearms, though the records for the right arm show a little more fluctuation.

The curves for strength of the upper back show that No. (*1*)



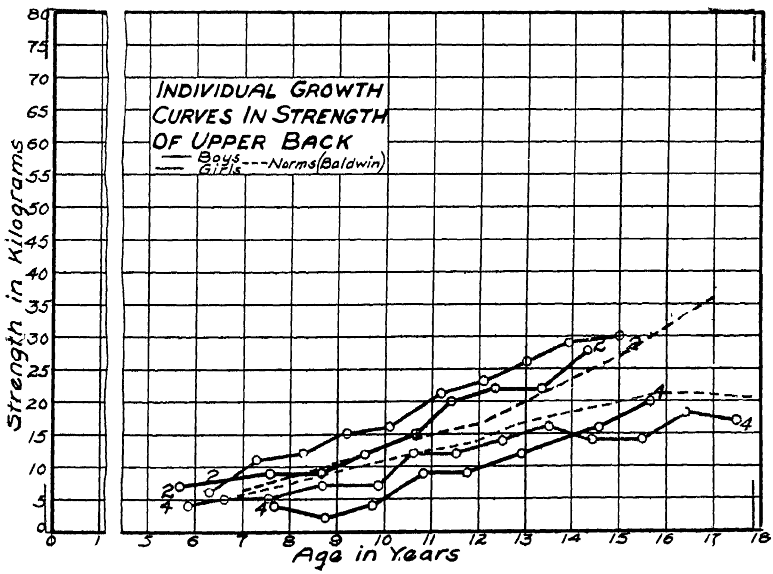


Chart XXIX

is relatively weak, with much fluctuation in performance; No. (*2*) is steady in development but not so strong as his weight would indicate; No. (*3*) is fairly uniform in growth, as his other traits show; and (*4*) shows a steady tendency not to make adequate gains in strength, his record being even less than his smaller stature would lead one to expect.

(b). *Girls.* In the strength series (*3*) and (*4*) are inferior to (*1*) and (*2*), and (*1*) slightly inferior to (*2*), for the right forearm. A similar distribution holds true for the left forearm. In strength of upper back (*2*) shows a steady good growth, (*1*) improves but does not exceed (*3*), and (*4*) shows relatively little growth during the twelve years of school life.

Conclusions (Set 1 and Set 2)

1. HEIGHT

I. For boys and girls from six to 18 years of age there is a slight adolescent acceleration in height, sitting height, weight, breathing capacity and the strength traits which appears earlier for girls than for boys and earlier for tall girls or boys than for those below the norms.

II. A series of individual growth curves of varying heights approximates in form a series of concentric arcs of varying sizes where a chronological point in the lower arcs is reached later than a corresponding point in the upper arcs.

III. As a rule tall boys and tall girls reach their periods of maximum adolescent stature earlier than do short ones.

IV. If the increments of growth in stature before adolescence are relatively uniform (*i. e.* represented by a straight line on the charts) this uniformity of increase tends to persist throughout adolescence. If there is retardation before adolescence the tendency is to show a rapid acceleration during adolescence, as a compensating factor.

V. With boys and girls the stature curves show a railroad appearance with relatively little crossing but a tendency to fan out at adolescence.

VI. Tall children at any age remain relatively tall under normal conditions. Growth in height is so comparatively uniform for each individual that the growth curve enables one to prophesy with a high degree of accuracy how tall a young child will be at subsequent years.

VII. Growth in height is affected by the formation and removal of adenoids.

VIII. Prolonged disease history retards normal growth in stature.

2. WEIGHT

I. Growth curves in weight from seven to 17 years of age tend toward concavity; those in height toward convexity.

II. There is more individual variation in growth in weight than in growth in height.

III. Pre-adolescent acceleration in growth of weight precedes as a rule the pre-adolescent acceleration in growth in height.

IV. The pre-adolescent acceleration in growth in weight is earlier, chronologically, for the tall boys or girls than for the short ones.

V. Growth in weight is affected by disease history and the growth and removal of adenoids.

3. SITTING HEIGHT

I. The trend and distribution of individual curves in sitting height are almost identical with the trend and distribution of the standing height curves for boys and for girls, more particularly for boys.

II. The conclusions outlined on page 92 for individual growth in stature apply in general for individual growth in sitting height.

III. Growth in sitting height is affected by disease and adenoids, as in the case of standing height.

IV. Sitting height standards are more satisfactory from an anthropometric point of view than those for standing height.

4. CHEST GIRTH

I. Chest girth for girls is relatively less than for boys during the pre-adolescent period.

II. Cessation in growth of chest girth occurs earlier for girls than for boys.

III. Development of chest girth does not parallel growth in stature, as do the other traits previously mentioned.

5. BREATHING CAPACITY

I. Measurements of growth in breathing-capacity involve a *mental factor* which differentiates this measurement from those of height, weight, sitting height and chest girth.

II. Individual breathing capacity curves, like those for weight, tend

toward concavity, which is more marked in the boys' curves than in the girls'.

III. There are marked individual variations in the breathing capacity curves.

IV. Larger and taller children as a rule have greater breathing capacity than smaller ones.

V. Girls show inferior development in breathing capacity to boys.

VI. Girls reach their periods of cessation of growth before boys.

VII. Taller, heavier boys and girls as a rule have their accelerated periods of growth in breathing capacity at an earlier period than do those below the norms in height and weight.

VIII. Retarded development in stature and weight is paralleled by retarded development in breathing capacity.

6. STRENGTH OF ARMS AND UPPER BACK

I. Individual strength curves for arms and upper back are similar in irregularity to the breathing capacity curves.

II. As in the breathing capacity curves, the element of voluntary effort plays an important rôle in evaluating the development of strength.

III. Girls are inferior to boys in all strength tests, girls showing, after 15 years of age, little increase, and frequently a decrease in strength.

IV. The right arm as a rule for both boys and girls is stronger than the left, but the difference is not so marked as has usually been assumed.

V. In the distribution of strength curves, there is more overlapping, with marked fluctuations in increments of improvement or regression in individual strength curves than in the case in curves of height, weight, breathing capacity, sitting height and chest girth.

VI. The observed correlation between individual stature and strength curves is not so evident as in the other traits previously outlined.

VII. Development in strength of right arm, left arm and upper back is materially affected by prolonged disease history.

C. INDIVIDUAL CURVES, BROTHERS AND SISTERS, SET 3.

(1) *Height* (a). *Brothers*. In this series of Charts XXX to XXXVII two sets of brothers—(*1*) and (*2*), and (*3*) and (4) are

given for comparison, and two sets of sisters (*1*) and (*2*), and (*3*) and (*4*). It will be noted in the case of the boys that the taller boy (*1*), who is the younger brother, is 7.7 cm. taller at 16 years of age. In accordance with the laws of growth previously stated, p. 92 the taller brother (*1*) reaches the period of accelerated growth earlier—11 years, 2 months—and the shorter (*2*), later—11 years 9 months. The taller (*1*) also reaches the period of diminishing increments earlier—13 years, 10 months—and the smaller (*2*) later—14 years, 9 months. The widest range of difference is at 11 years, 9 months, when the taller (*1*) has started his adolescent acceleration and the shorter (*2*) is in the period of pre-adolescent cessation of growth, the difference being 12 cm.

If the curves of growth are thought of as parallel or concentric curves which give an index of physiological stages of growth, it will be noted that at the chronological age of seven years for the taller boy (*1*) and seven years nine months for the shorter boy (*2*), the actual difference in height is 2½ cm.; at eight years for the taller (*1*) and eight years eight months for the shorter (*2*) the difference is 3 cm.; at nine years for the taller (*1*) and nine years 11 months for the shorter (*2*) the difference is 4 cm. At 12 years for the taller (*1*) and 13 years 3 months for the shorter (*2*), the difference in height is 3.8 cm. The growth of these two brothers is strikingly similar and the curves are typical of the normal standard growth curves. In chronological age the taller boy (*1*) is four years in advance of the other (*2*).

The other two brothers, (*3*) and (*4*), differ relatively in height about the same as (*1*) and (*2*), but both are shorter. They differ chronologically seven years, the taller boy (*3*) being the younger. The trend of the curve of the shorter boy (*4*) shows that he is physiologically younger at a given chronological age than (*1*) or (*2*).

(b). *Sisters.* For the two pairs of sisters the uniformity of growth in height is almost as regular as for the four boys, although both sets of sisters manifested more ill health and a longer disease history. The tallest girl and her shorter sister differ greatly in height, but the difference is constant. The removal of adenoids at 12 had little apparent effect on growth in stature for (*1*); (*2*) shows a retardation in growth in height after 13½ years, when the health notes state she was "nervous" and had had enlarged tonsils. No.

(*1*) matured at 14 years 5 months of age, and No. (*2*) at 14 years 6 months. No. (*2*) is the older sister, chronologically.

The other two sisters whose growth curves are shown in the charts are very nearly the same height; the shorter one (*4*) is just

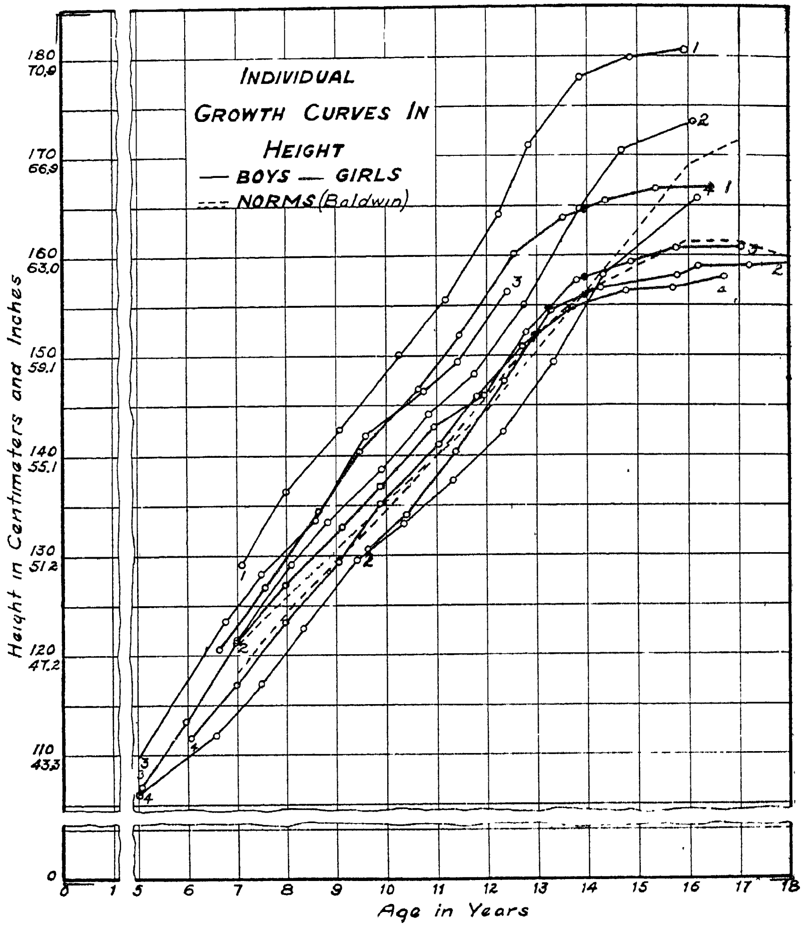


Chart XXX

one year older chronologically than (*3*). The former (*3*) was anaemic at 9 years of age, had poor circulation and later developed round shoulders and had slightly enlarged tonsils; the latter (*4*) had her tonsils removed at 12½ years of age; her health in general was better than her sister's (*3*).

(2) *Weight.* (a). *Brothers.* The weight curves for the two sets of brothers are in accord with the general results for height; the two taller boys are also the two heavier during the interval from five or seven to 17 years of age, assuming that (*3*) continues to

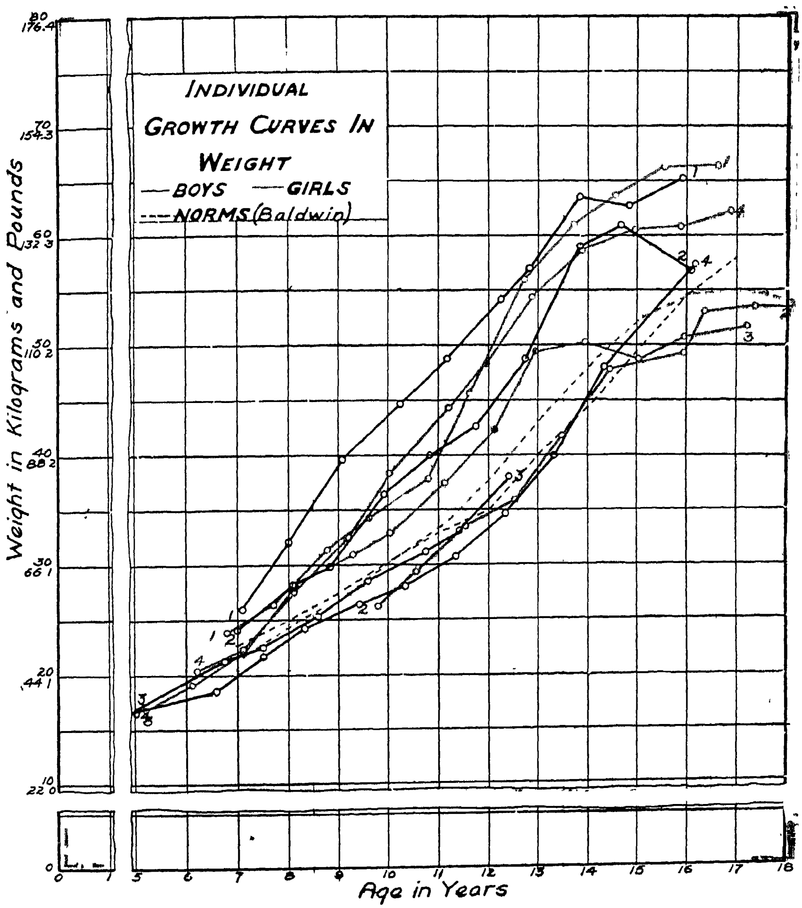


Chart XXXI

grow as he has in the past. No. (*2*) was apparently ill at 16 years of age, but the exact nature of the illness is not recorded. The healthy robustness of these four boys is evident in the weight curves.

(b). *Sisters.* For the girls the same signs of irregular development are present that were found for growth in height. No. (*1*) lost weight before the removal of adenoids at 12 years of age, but

rapidly regained her superior position again after the operation. Her sister (*2*) shows a decline in weight after 14 years of age. For (*3*) and (*4*) it may be noted that (*4*)'s development is fairly regular, but (*3*) loses weight markedly after 13 years of age, and for the remainder of her school life the weight history is a discouraging one. The former (*3*) matured between 13 and 14 years of age, the latter (*4*) at about 13 years of age. Whether the drop in the curve of growth in height for (*3*) is due to the anaemia, the round

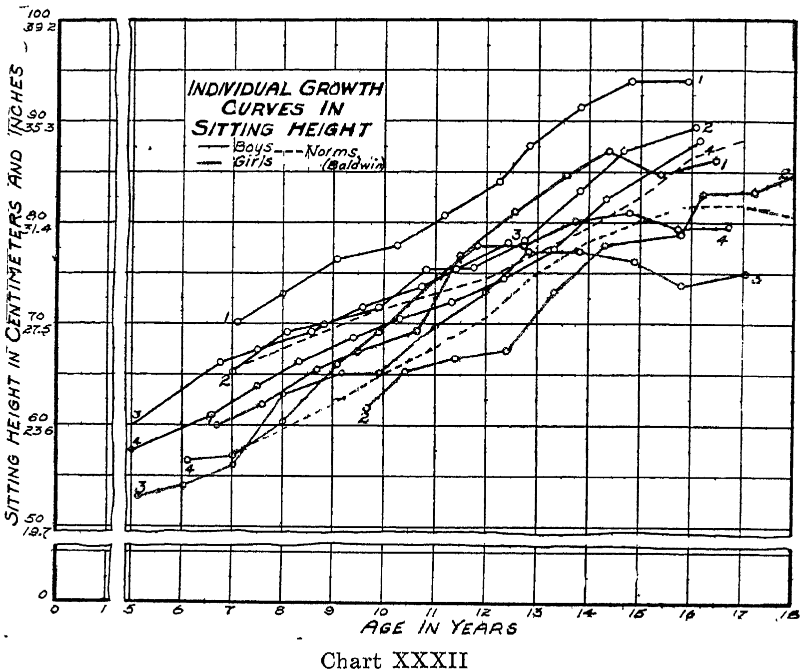


Chart XXXII

shoulders, the enlarged tonsils or the slightly delayed maturity is not clear, but the curve illustrates the growth principle previously formulated that if growth in height is retarded for a short time, there is an additional increase subsequently and the normal relative position is attained.

(3) *Sitting Height.* (a). *Brothers.* In sitting height the general course of development of the brothers (*1*) and (*2*) is the same as in the standing height, the taller having the advantage; the other brothers (*3*) and (*4*) also hold their relative positions as in height. Children of the same family may differ in the proportion of height

sitting to height standing and this would explain the overlapping of curves (*2*) and (*3*), which does not occur in the height curves.

(b). *Sisters.* For sitting height sisters (*1*) and (*2*) hold approximately their same relative positions as in height, the distance between the curves remaining about the same during the growth period, although (*2*) varies a little more than (*1*). The other girls show the same likeness to each other in relative height sitting as standing at the beginning, but (*3*) having lost her relative height

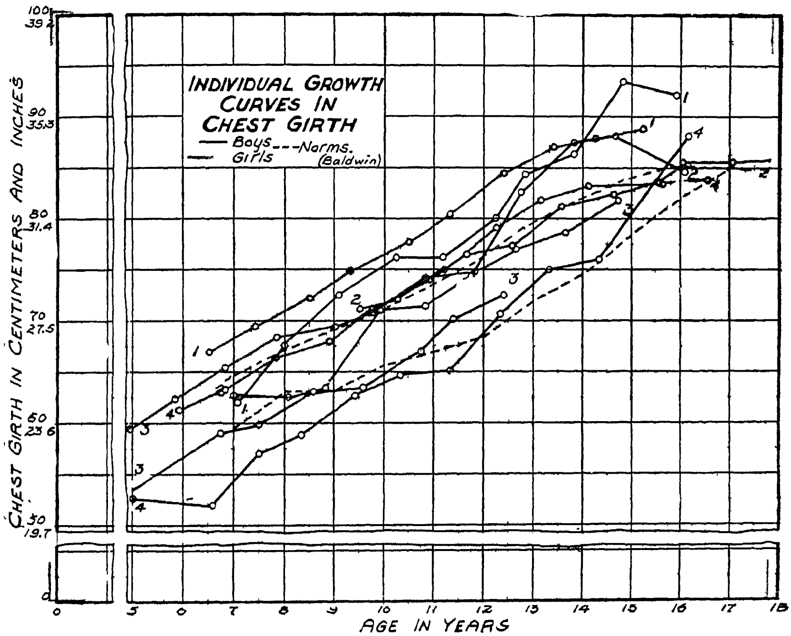
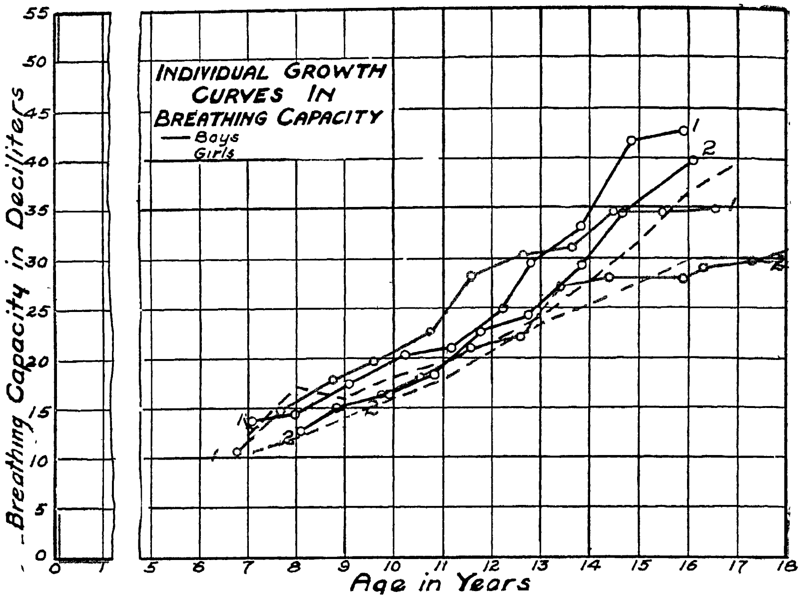


Chart XXXIII

sitting position with reference to (*4*), does not regain it. Is this due to round shoulders, weakness or posture? The other sisters also show, at the beginning, a parallel course of the curves for sitting height, just as for standing height. After a few years, however, (*3*) with a taller sitting height does not continue to grow at the same rate; her curve drops down nearer to the level of (*4*)'s and never rises again to the height it might have attained if growth had been uninterrupted. The cause of the interruption is not clear, but posture, round shoulders or weakness might furnish an explanation.


INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

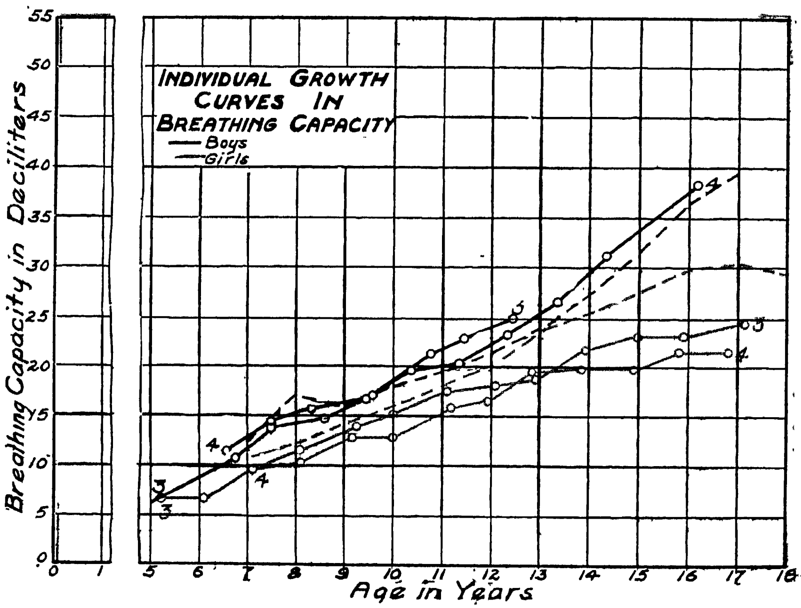
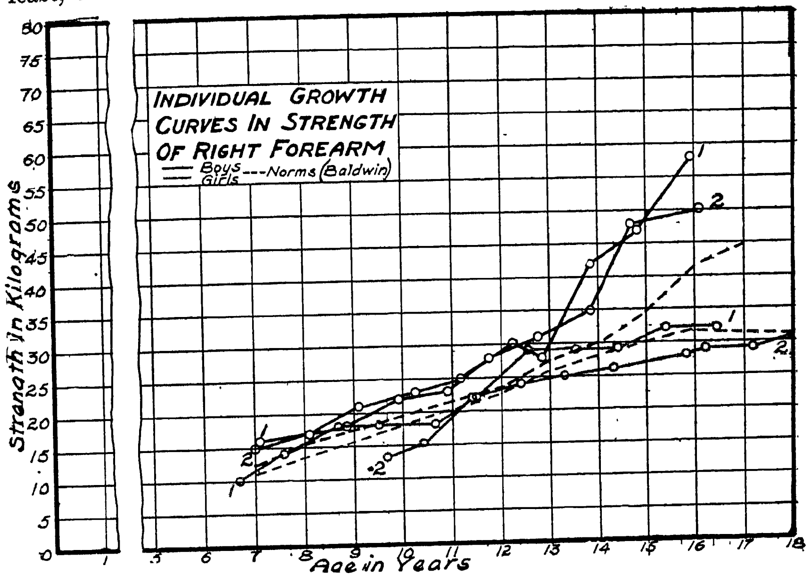

INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

Chart XXXIV

(4) *Chest Girth.* (a) *Brothers.* For chest girth there are more fluctuations in all of the curves. This may be attributed, in part at least, to the unreliability of this measurement, due to the fact that



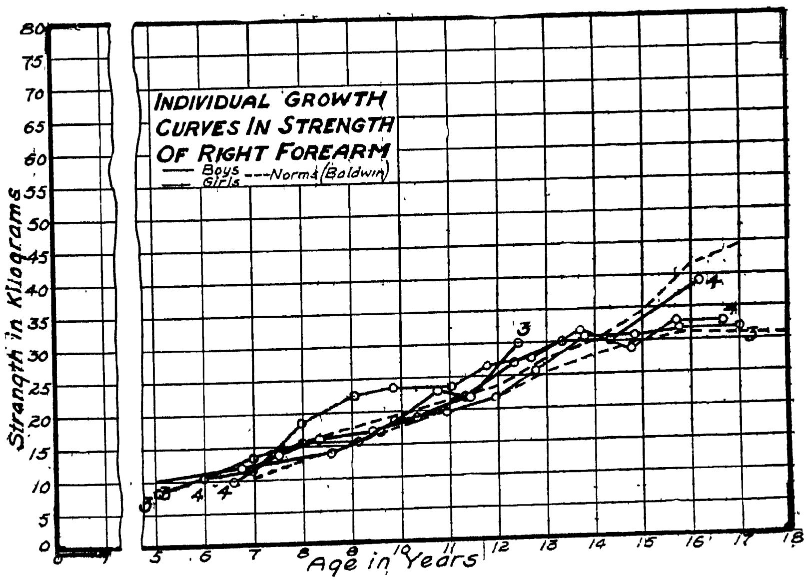
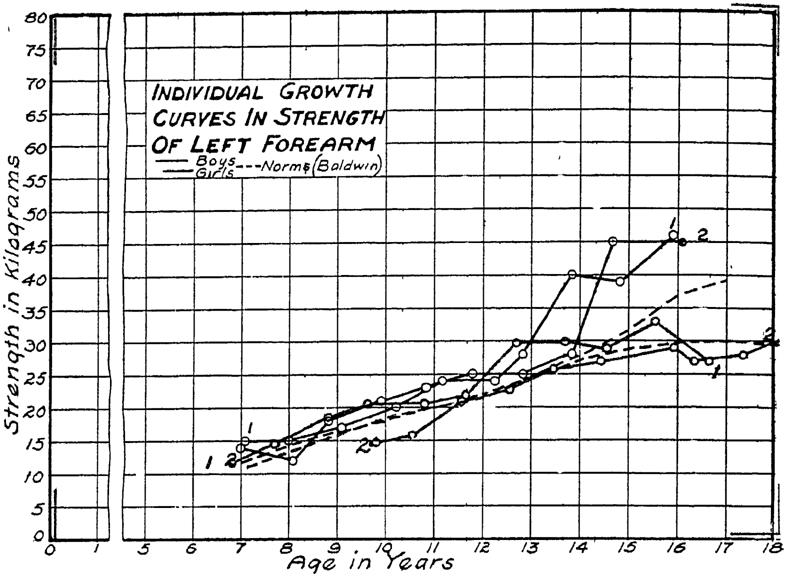


Chart XXXV

the muscle tissue of the chest makes it difficult to maintain an equal degree of tautness of the tape and also the fact that the volume of air in the lungs can not be kept constant from year to year.



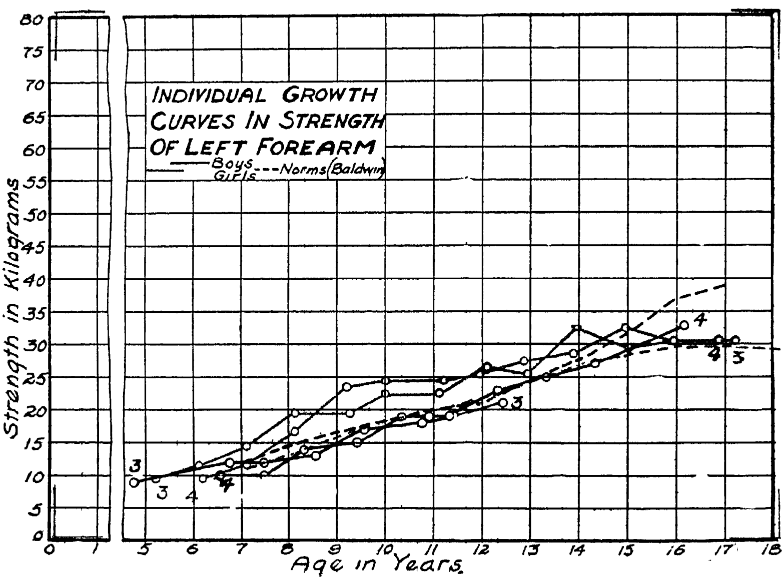
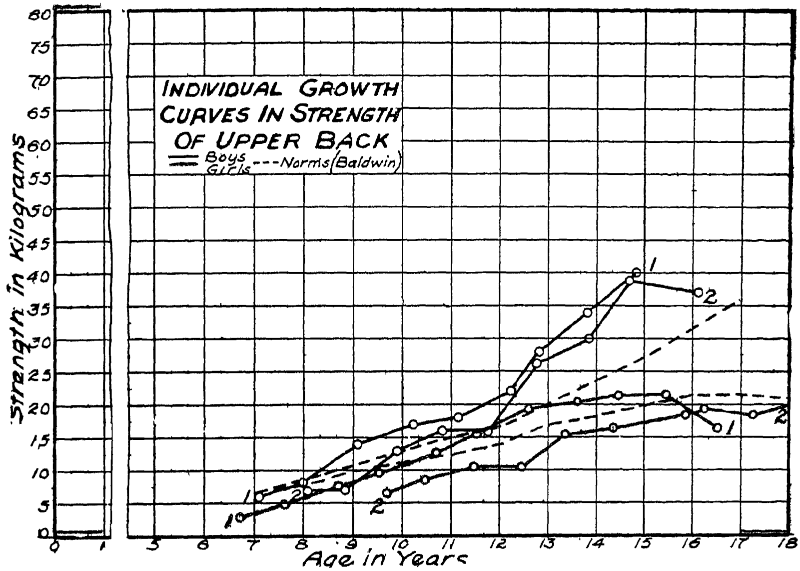


Chart XXXVI

The smaller brother (*2*) fluctuates more than (*1*), showing a marked acceleration at 12 to 14 years of age and a distinct regression at 16 years of age. The other brothers (*3*) and (*4*) show less fluc-



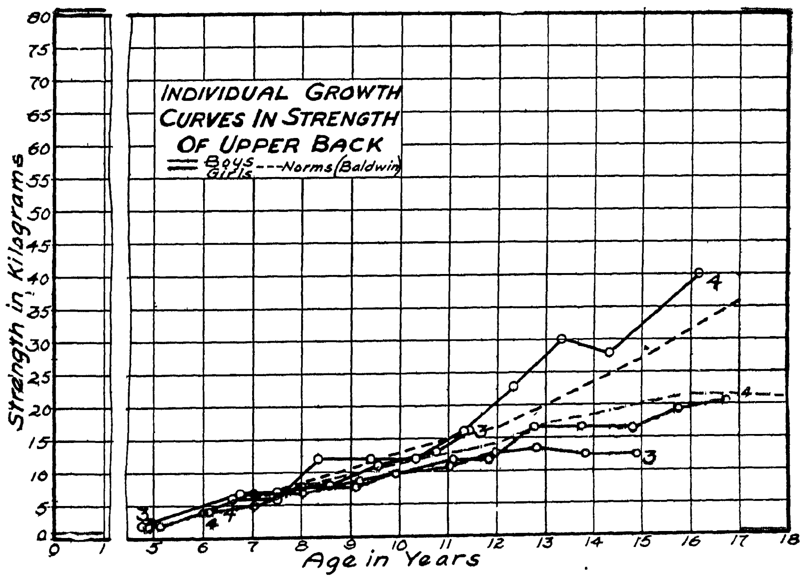


Chart XXXVII

tuation and their relative development is similar to their relative development in height.

(b). *Sisters.* For the two pairs of sisters, the girths of chests vary even more than for the brothers, both among themselves and among the group. The period of greatest acceleration is earlier for the girls, no doubt due to muscular and glandular development, as well as to actual increase in breathing capacity. The slowing up of growth starts very early for (*1*), (*2*) and (*3*). The anaemic condition, round shoulders and poor health of (*3*) show in a striking manner in this measurement. The poor health of all of the girls is apparent here, regardless of the fact that all are receiving remedial exercises.

(5) *Breathing Capacity.* (a). *Brothers.* In breathing capacity (*1*) and (*2*) are above the norm and maintain their relative position to each other while (*3*) and (*4*) approach the norm for the group.

(b). *Sisters.* The two pairs of sisters hold relatively the same position as the two pairs of brothers.

(6) *Strength of Arms and Upper Back. Arms.*

(a). *Brothers.* The development in strength for the two pairs of brothers varies from the development of the other physical traits in that the same relative positions are not maintained. (*1*) and (*2*) are still superior to (*3*) and (*4*), but (*2*) is here almost as strong as (*1*) and (*3*) exceeds (*4*) by only a small degree. The curves for strength indices are comparatively regular.

(b). *Sisters.* With the sisters (*1*) and (*2*) are equal in strength at 11 years 4 months, but (*1*) later regains her supremacy. Neither are very strong for girls. For (*3*) and (*4*) the curves are flattened and as in the case of the other two sisters, there has not been the growth found in normally developed girls with good health.

Upper Back.

(a). *Brothers.* For development in strength of upper back the smaller of the first set of brothers (*2*) almost equals the larger and heavier one (*1*), and (*4*), the smallest of the group, equals (*1*), the largest, in this physical trait. The other brother (*3*) also shows a close resemblance to (*4*) as far as comparison is possible. In strength development for these four boys of good normal growth, there is less difference between brothers and less difference between the two pairs than for the other traits.

(b). *Sisters.* For the two pairs of sisters in strength of upper back (*1*) is superior until 16 years of age when there is a decrease;

for the smaller sister (*2*) the development is similar to (*1*) but inferior until 16 years of age. Of the other two sisters (*4*) is as strong at all ages as (*3*) or superior and at 17 she is superior to (*1*) and (*2*).

These comparative curves show that while two brothers or two sisters may differ in the gross measurements in the various traits shown, there is a similarity in proportional increment of growth for the pairs, except in the strength tests, where the individual gross differences between two brothers or two sisters is not so marked.

(7) *Conclusions*

1. HEIGHT.

I. The individual growth curves in stature of two brothers or two sisters show that the one may be taller than the other, but the curves are strikingly similar in their appearance.

II. If the curves of growth are thought of as parallel or concentric curves which give an index of physiological stages of growth, it will be noted that for the first two brothers, (*1*) and (*2*), the relative variation in height at any one physiological age is not more than a few centimeters. The second pair of brothers shows very little variation in relative height.

2. WEIGHT.

I. Variations in weight for brothers and for sisters are more marked than in development in stature.

II. In the case of the two pairs of sisters, there is more variation in weight, which is probably due to the prolonged disease history of each.

3. SITTING HEIGHT.

I. Sitting height shows more variations than standing height, probably due to round shoulders and poor posture.

4. STRENGTH OF ARMS AND UPPER BACK.

I. Boys and girls who hold their relative positions in development in stature do not, in these cases, maintain the same relative positions in strength of arms and upper back.

II. These comparative curves show that while two brothers or two sisters may differ in the gross measurements in the various traits shown, there is a similarity in the proportionate incre-

ment of growth for the pairs, excepting the strength tests, where the individual gross difference between two brothers or two sisters is not so marked.

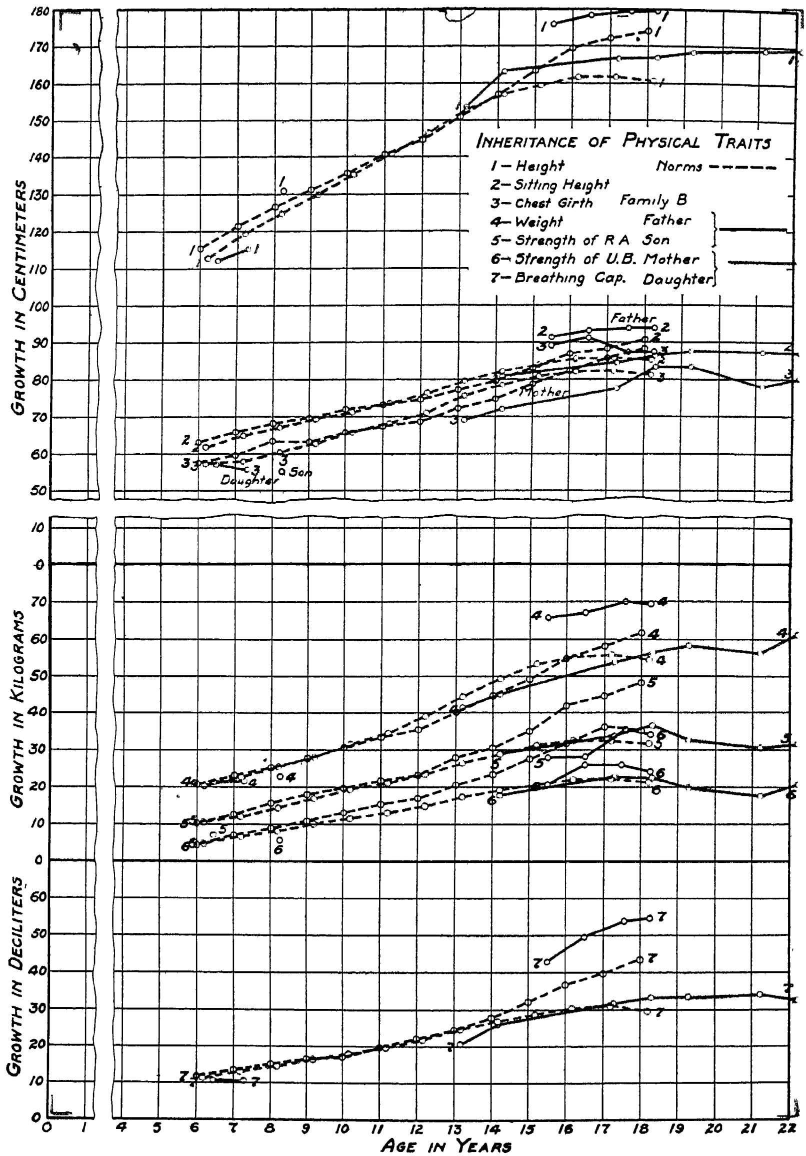


Chart XXXVIII

D. THE INHERITANCE OF PHYSICAL TRAITS

A preliminary study is now being made of the inheritance of physical traits. Chart XXXVIII represents a method of recording the growth data. In family B the mother's measurements are given from 1900 to 1909, beginning at 13 years of age; the father's measurements begin at 15½ years in 1902, and the daughter's at six years three months, in 1919, and the son's in 1919 at the age of eight years three months.

In another family, for example, the measurements were taken from 12 years to 17½ years for the mother, and for the daughter from seven to 10 years of age; in another family the father's measurements have been carefully taken from 12 to 18 years of age, one daughter's from seven to nine years of age, another from 10 to 11 and another from six to seven years of age. In another family the mother's measurements were carefully recorded from 16 to 21 years of age, the daughter's from six to eight years of age, and the son's from four to five years of age. These measurements will be continued and in the course of a few years a definite report on family histories will be issued.

E. INDIVIDUAL PERCENTILE PROFILES OF GROWTH

The percentile increase in growth for individuals, as far as the writer can determine, is here worked out for the first time by means of consecutive profiles. In charts XXXIX to XLI are shown the percentiles in a series of individual profiles for two boys and two girls from seven to 17 years of age for eight to 12 successive measurements on a series of from 15 to 22 physical traits. The first column at the left gives the age of the child, the ordinates represent physical traits, and the abscissæ the percent of gain over the initial measurement at the lowest age indicated. This first series of measurements in each trait is taken as 100 percent for the trait indicated. The circles mark the percent of growth in each particular physical trait. The curves (the heavy lines and circles) give a cross section view of the percental growth of the individual for the time period included and the series gives the successive profiles. Tables XIII, XIV, XV on pages 108, 109 and 110 give type cases.

In table XIII there are shown the initial measurements in twenty-two traits for a boy of five years, 11 months old, and the percent of gain for the successive time intervals is indicated to the age of 16 years and seven months. The results for height, for ex-

TABLE XIII

PERCENT TABLE OF INDIVIDUAL GROWTH FROM KINDERGARTEN THROUGH HIGH SCHOOL. BOY*

Traits	5 yrs. 11 mos. Initial Meas. 100%	6 yrs. 8 mos. % gain	7 yrs. 10 mos. % gain	8 yrs. 8 mos. % gain	9 yrs. 11 mos. % gain	10 yrs. 8 mos. % gain	11 yrs. 9 mos. % gain	12 yrs. 10 mos. % gain	13 yrs. 11 mos. % gain	15 yrs. 7 mos. % gain	16 yrs. 7 mos. % gain
1. Height	118.0	3.05	8.98	12.01	19.00	22.05	26.2	29.4	32.7	38.2	45.7
2. Sitting Height	62.2	4.84	8.37	12.89	15.75	17.85	21.1	23.3	25.5	29.9	37.3
3. Girth, Chest	59.6	9.73	5.04	8.73	12.09	17.10	20.3	25.0	25.5	34.4	43.2
4. Girth, Chest exp.	63.2	6.65	4.75	8.55	14.90	15.50	20.6	25.0	29.75	32.6	34.8
5. Girth Ninth Rib	58.4	6.16	3.42	8.56	14.70	13.90	18.2	20.7	21.6	25.17	35.3
6. Girth Ninth Rib exp.	60.0	8.66	6.00	10.00	15.33	15.33	20.5	23.34	26.76	30.00	38.3
7. Depth Chest	14.8	8.11	1.35	—1.35	4.5	4.5	4.73	6.08	12.16	16.89	16.2
8. Depth Chest exp.	15.2	11.85	5.26	7.89	9.22	11.18	15.8	19.0	32.7	30.4	26.6
9. Breadth, Chest	19.0	7.36	7.36	8.42	13.7	15.76	17.9	22.1	23.7	30.0	37.4
10. Weight	22.3	19.3	29.15	35.90	56.8	65.40	82.5	101.2	109.9	119.8	168.5
11. Lung Capacity	50.0	48.0		76.00	94.0	108.0	120.0	160.0	188.0	208.0	284.0
12. Strength, Forearm R.	12.0	16.7	16.7	50.10	66.8	100.0	108.0	108.0	175.0	158.0	291.0
13. Strength, Forearm L.	12.0	16.7	25.0	50.10	66.8	75.0	75.0	75.0	100.0	133.3	241.5
14. Strength, Upper Back	5.0	20.0	120.0	140.00	180.0	220.0	280.0	380.0	420.0	380.0	500.0
15. Strength, Chest	10.0	20.0	50.0	50.0	100.0	110.0	130.0	140.0	180.0	210.0	260.0

* Horace Mann School.

TABLE XIV

PERCENT TABLE OF INDIVIDUAL GROWTH FROM KINDERGARTEN THROUGH HIGH SCHOOL. GIRL*

	7 yrs. 2 mos.	8 yrs. 0 mos.	8 yrs. 11 mos.	10 yrs. 0 mos.	10 yrs. 11 mos.	11 yrs. 11 mos.	13 yrs. 11 mos.	14 yrs. 11 mos.	16 yrs. 3 mos.	16 yrs. 9 mos.
Traits	Initial Meas. 100%	% gain	% gain	% gain	% gain	% gain	% gain	% gain	% gain	% gain
1. Height	118.6	3.38	8.27	13.3	17.2	22.4	23.05	24.7	25.25	25.80
2. Height, Sitting	66.0	1.52	6.06	9.1	12.1	17.3	22.7	25.15	29.4	30.9
3. Girth, Chest	58.4	9.58	10.95	18.2	18.5	22.3	35.3	48.3	48.3	50.3
4. Girth, Chest exp.	60.8	9.21	10.5	17.75	16.8	22.7	36.8	45.7	45.7	49.3
5. Girth, Ninth rib	57.0	7.02	8.77	17.55	17.9	19.3	31.6	35.1	43.2	45.9
6. Girth, Ninth rib exp.	59.0	10.15	10.85	18.65	19.0	22.35	33.9	39.0	43.3	45.7
7. Depth Chest	14.0	4.28	7.14	7.14	11.42	11.42	25.7	32.8	35.7	39.3
8. Depth Chest exp.	15.0	1.33	5.35	8.00	10.68	12.0	21.3	28.0	30.6	32.0
9. Breadth, Chest	18.4	6.53	7.60	15.2	15.2	19.59	29.4	37.5	38.1	42.9
10. Weight	26.1	8.43	13.04	29.5	34.8	50.2	99.2	89.7	91.6	101.0
11. Lung Capacity	60.0	30.0	40.0	40.0	70.0	103.0	156.4	183.4	180.0	190.0
12. Strength, Forearm R.	12.0	00.00	16.68	50.00	50.00	100.00	150.0	158.3	158.3	183.4
13. Strength, Forearm L.	8.0	37.5	75.0	125.0	125.0	175.0	225.0	287.5	300.0	287.5
14. Strength, Upper Back	6.0	83.3	100.0	150.0	150.0	150.0	200.0	300.0	300.0	266.6
15. Strength, Chest	6.0	116.8	116.8	166.8	200.0	200.0	266.6	266.6	400.0	423.3

* Horace Mann School.

ample, show that for the first interval (nine months) there has been a gain of 3.05 percent, for the second period of 14 months, 8.98 percent, and so on until the last age, 16 years, seven months, where the gain has amounted to 45.7 percent over the first meaurement. In strength of upper back there has been a gain of 500 percent. For the depth of chest, the results show that there has

TABLE XV

PERCENT TABLE OF INDIVIDUAL GROWTH FROM 11 YEARS TO 16 YEARS, SEVEN MONTHS*

Age	11 years	16 years 7 months
	Initial Meas.	% gain
1. Weight	29.0	47.9
2. Height, Standing	139.6	17.4
3. Height, Sitting	74.6	12.2
4. Girth, Neck	26.9	8.22
5. Girth, Chest (Repose)	68.5	10.50
6. Girth, Chest, (Inf.)	71.5	13.4
7. Girth, 9th Rib, (Repose)	59.3	12.2
8. Girth, 9th Rib, (Inf.)	62.3	16.1
9. Girth, Waist (Repose)	56.5	10.3
10. Girth, Waist, (Inf.)	57.8	9.34
11. Girth, Hips	65.2	15.6
12. Girth, Thigh, (R.)	37.4	13.9
13. Girth, Thigh, (L.)	36.3	16.8
14. Girth, Calf, (R.)	26.3	17.9
15. Girth, Calf, (L.)	25.7	20.2
16. Girth, Up. Arm, R. (Ext.)	17.6	19.3
17. Girth, Up. Arm, R. (Flex.)	19.0	23.7
18. Girth, Up. Arm, L. (Ext.)	17.2	16.3
19. Girth, Up. Arm, L. (Flex.)	18.9	16.9
20. Girth, Forearm, (R.)	19.6	20.4
21. Girth, Forearm, (L.)	19.1	15.2
22. Breadth, Shoulders	30.8	16.9
23. Breadth, Chest	20.4	11.8
24. Breadth, Waist	19.5	20.5
25. Breadth, Hips	22.1	23.1
26. Depth, Chest	16.0	12.5
27. Depth, Abdomen	15.5	3.23
28. Strength, Back	55.0	63.6
29. Strength, Legs	70.0	100.0
30. Strength, Chest	18.0	69.4
31. Strength, Forearm, (R.)	17.0	47.1
32. Strength, Forearm, (L.)	17.0	47.1
33. Capacity, Lung	143.0	32.9

* Baltimore Friends' School

been a gain of 16.2 per cent at the final measurement, 16 years, seven months, over the initial measurement at five years, 11 months.

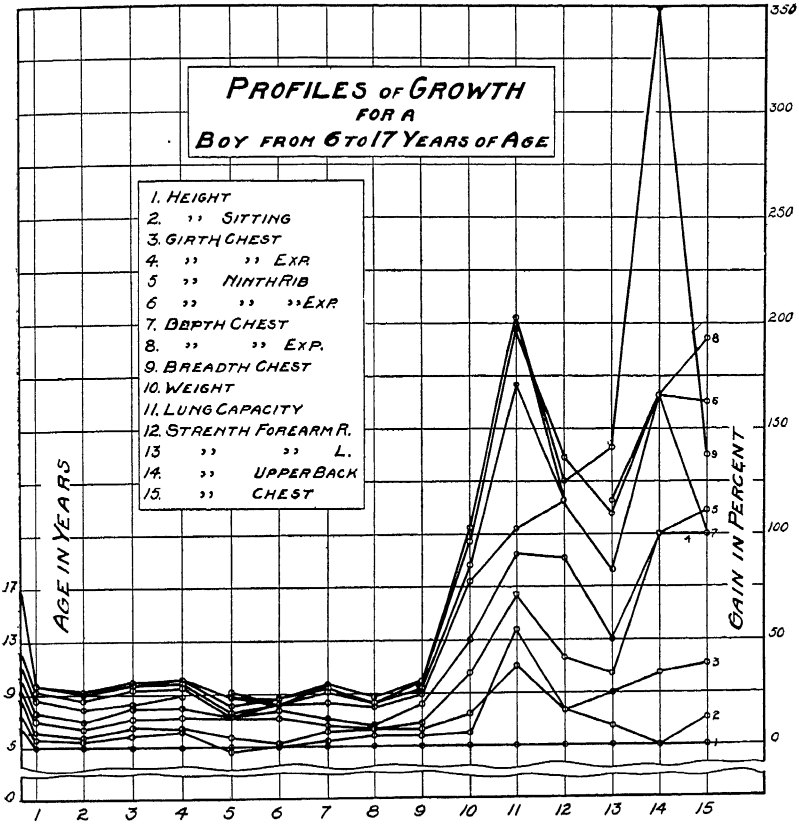


Chart XXXIX

1. *Conclusions*

I. The synoptic profiles for the individual boys differ from those for the girls. Except in height, standing and sitting, and weight, the girls show a higher percent of gain over the initial growth, taken as 100 percent, than do boys. This is particularly true of all of the strength measurements. For the nine traits considered previous to weight, the percent of gain for the eight to ten year interval, in the case of the boys, is always less than 50 percent and frequently not more than 25 percent. None of the strength tests for the boys exceeds 210 percent except in one instance for upper back, while for the girls

strength of the arms, back and chest frequently exceeds this amount and with one girl strength of right forearm reaches 350 percent, strength of chest 420 percent, and strength of upper back 850 percent.

II. The consecutive profiles for the same individuals are similar in their depressions, plateaus and peaks, with the greatest variation in the strength measurements.

III. The individual profiles furnish a tangible method for clinical diagnosis of the growth of individuals.

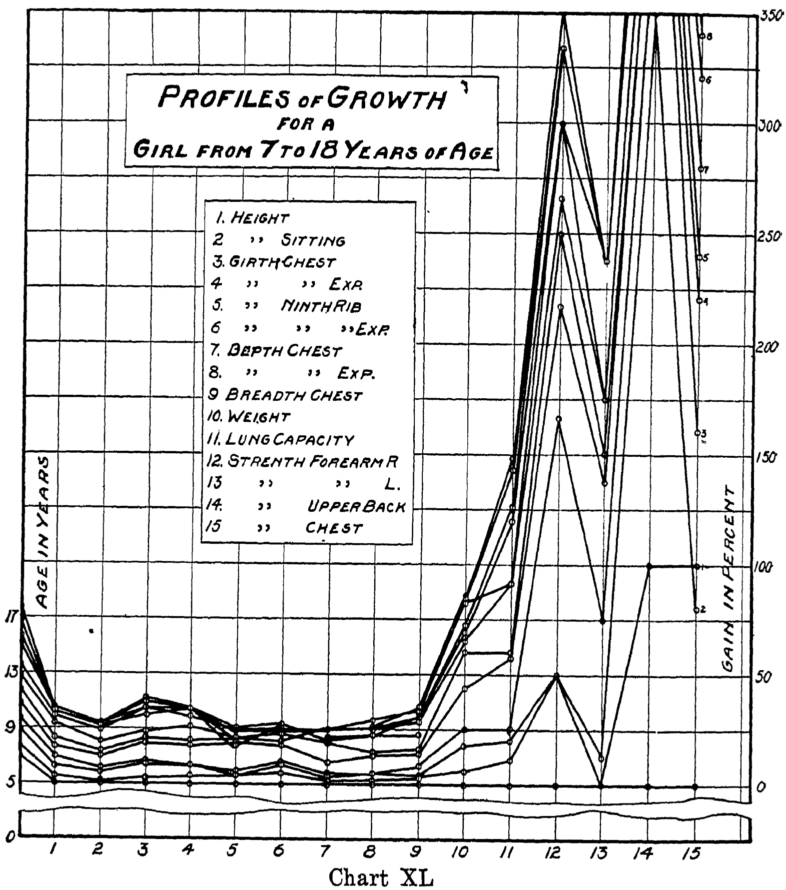


Chart XL

2. *Applications*

The consecutive profile charts furnish a practical means for recording the consecutive development of individual children. In order to use this method, a school should have a number of the charts made from a plate, 100, 1000 or more as the conditions require. The "blank charts" should contain the measurements to be recorded and the cross sections as indicated in Charts XXXIX to XLII. One chart should be provided for each pupil. The age of the pupil at first measurement should be indicated on the left margin as the basal age and all of the first measurements on their respective abscissas (cross section points on the horizontal lines),

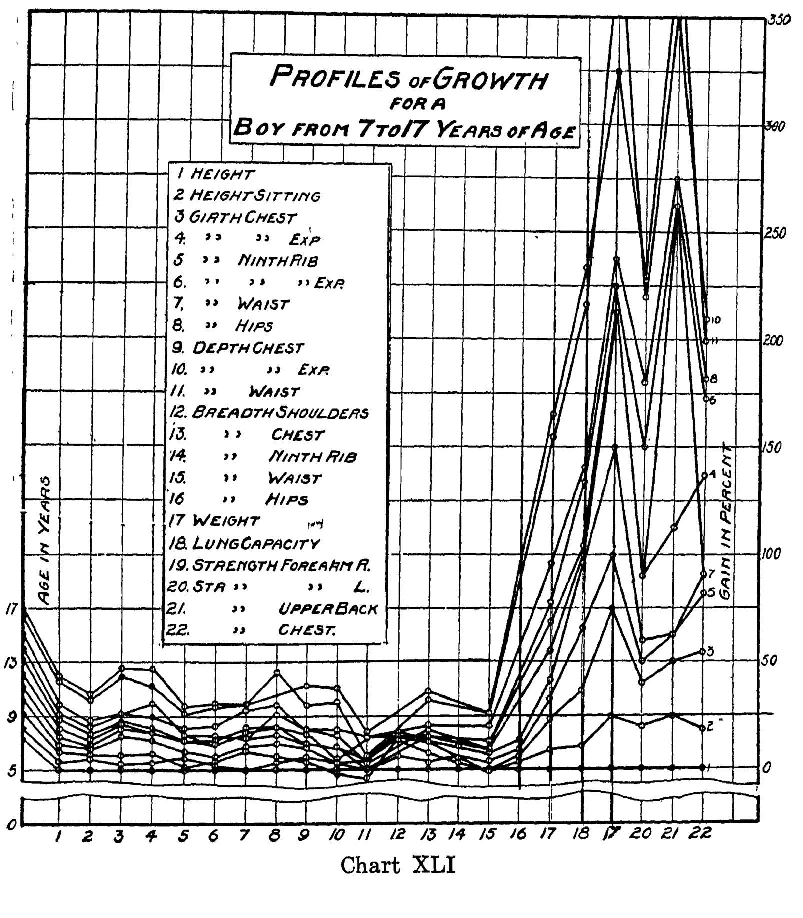


Chart XLI

at the 0 point. For the second measurement the age should be indicated on the left and the percents of gain over the initial measurements recorded on their respective ordinates (vertical lines) at relative distances from the 0 line. Each profile should be numbered in order (1st, 2nd, 3rd, etc.)

These profiles furnish excellent synoptic pictures of physical development for use by teachers, medical examiners, physicians, parents, and pupils. Another form of consecutive growth curves for nine physical traits is illustrated in Charts XLIII and LIV. Constructed from the records from Washington, D. C.

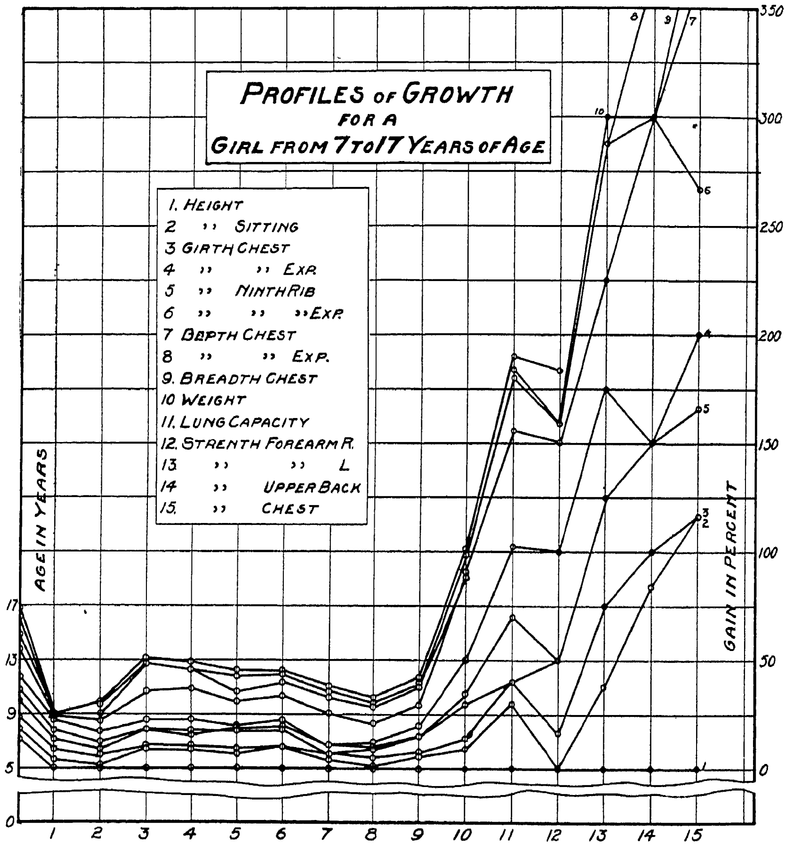


Chart XLII

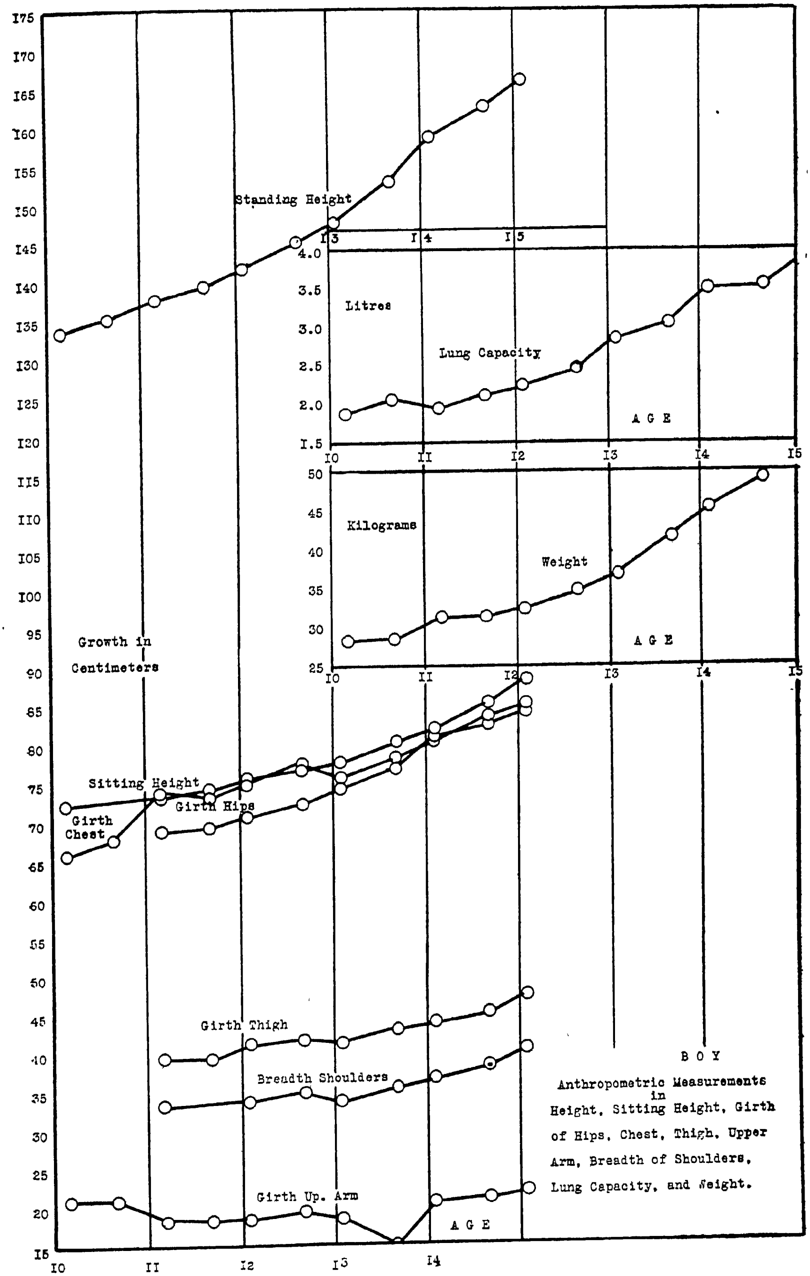

Standing Height
Litres
Lung Capacity
AGE
Kilograms
Weight
AGE
Growth in
Centimeters
Sitting Height
Girth Hips
Girth
Chest
Girth Thigh
Breadth Shoulders
Girth Up. Arm
AGE
BOY
Anthropometric Measurements
in
Height, Sitting Height, Girth
of Hips, Chest, Thigh, Upper
Arm, Breadth of Shoulders,
Lung Capacity, and Weight.

Chart XLIII

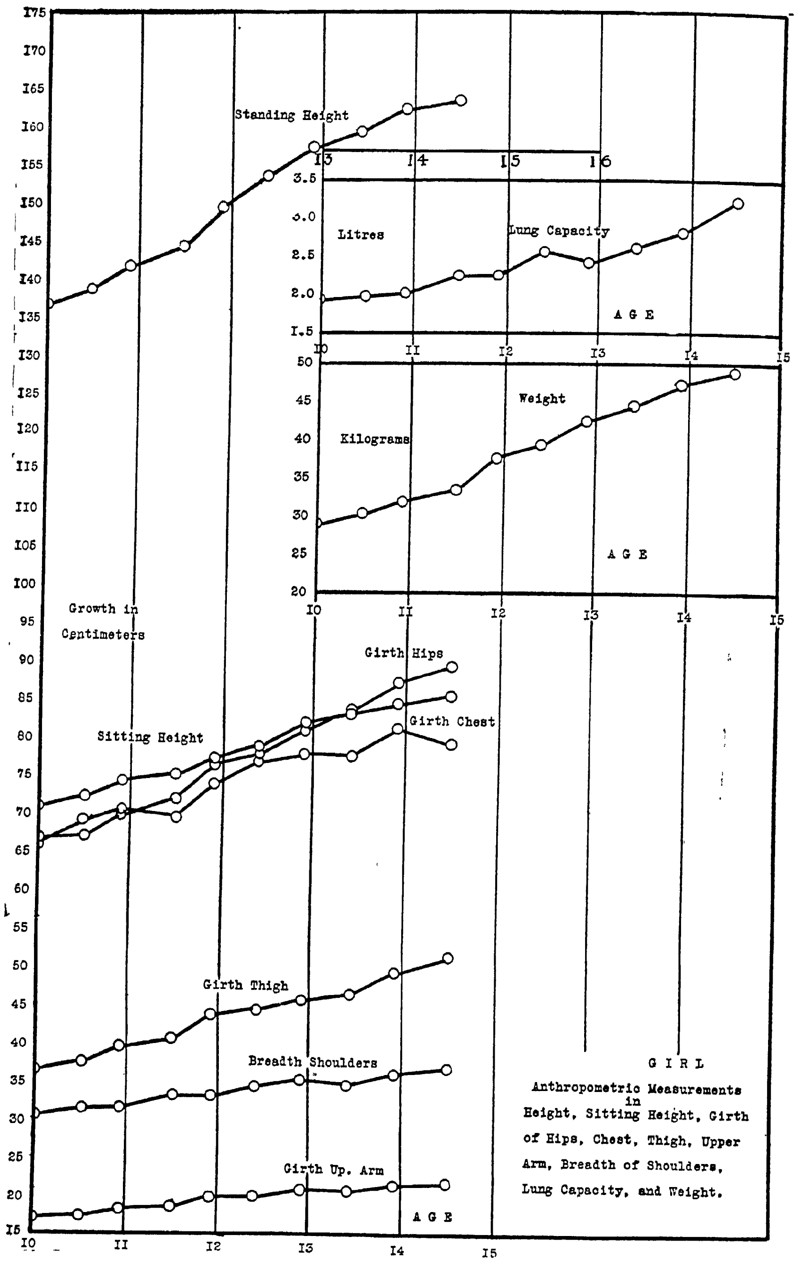

Standing Height
Litres
Lung Capacity
A G E
Weight
Kilograms
A G E
Growth in Centimeters
Girth Hips
Girth Chest
Sitting Height
Girth Thigh
Breadth Shoulders
Girth Up. Arm
A G E
G I R L
Anthropometric Measurements in Height, Sitting Height, Girth of Hips, Chest, Thigh, Upper Arm, Breadth of Shoulders, Lung Capacity, and Weight.

Chart XLIV

CHAPTER VI

CORRELATION COEFFICIENTS IN THE PHYSICAL GROWTH OF BOYS AND GIRLS

1. Total and Partial Growth

A. DATA.

This chapter gives briefly in a statistical and graphic form a summary of the correlations of the yearly measurements of growth in height, weight and breathing capacity, with sitting height, girth of chest, strength of right arm, strength of left arm and strength of upper back.

The investigation, of which this section is a partial report, aims to discover the relationships that exist between total growth of the body and the corresponding growth of a limited number of parts and psycho-physical functions when based upon consecutive measurements of the same individuals, in a group of boys and girls from the ages of seven to 17, and in another group of 80 college girls from 17 to 20 years of age.

For the school children the results are based on selected half-yearly consecutive measurements for periods from six to 10 years, on an average of 60 well developed children for each age for each sex. The original measurements were made on nude children who for several years had been subjected to school medical inspection, physical training and directed play. The semi-annual measurements made it possible to select a measurement which fell within at least three months of the child's exact birthday. The number of children could have been increased by including those with fewer or more irregular intervals of measurements and those deviating from the "normal type", but this seemed undesirable. The children represent good types of development, the measurements and the time intervals are accurate and the observations are consecutive for several years. For purposes of discovering relationships through the method of correlation, the numbers are sufficiently large and the probable error so uniformly small, that the tendencies discovered are no doubt accurate for this group of children, and may

serve as standards for comparison with different racial, economic, and mental types as to sex and age development. Correlations for the consecutive development of these physical traits for these ages or for a period of years with consecutive measurements have not been worked out before so far as the writer has been able to determine.

B. TABULATED RESULTS. (See pages 120 and 121).

2. Analysis of Correlated Traits: Total Correlations

A. SCHOOL CHILDREN.*

(1) *Height-Weight.* The correlations between the yearly measurements of height and weight during the ten-year period of childhood from seven to 17 years of age for both boys and girls are higher than the correlations between height and girth of the chest and strength of arms and upper back, but lower than the correlations between height and sitting height for both boys and girls. They are higher than the correlations between height and breathing capacity for boys, but lower for girls.

The relation between the yearly measurements of growth in height and weight for boys is relatively uniform from seven to 11 years of age (the coefficient of correlation varies from + .850 to + .876). The coefficient drops to + .782 and + .790 at 12 and 13 years of age and reaches the maximum, (+ .877) at 14 years. The coefficient is at the minimum (+ .668) at 16 years and is + .680 at 17 years. The correlation between height and weight is not so high for girls as for boys. For girls, the coefficient is + .581 at 11 years of age and reaches the maximum (+ .693) at 12 years of age. At 16 years the relationship is less marked, (the coefficient is + .486). The averages of the coefficients for the ten-year period are + .809 for boys and + .603 for girls.

(2) *Height-Breathing Capacity.* The correlations between the yearly measurements of height and breathing capacity are higher than the correlations between height and girth of chest, strength of arms and strength of upper back for both boys and girls. These correlations are higher than the height and weight correlations for girls, but lower than those for boys.

This section gives a direct analysis of the tabulated data without attempting to evaluate the significance of the minor fluctuations in the coefficients. In some instances the differences noted are within

* Data from Horace Mann School, Teachers College, Columbia University.

the range of the probable error; and they may or may not be significant.

Between these two traits, the relation is very high from seven to nine years for the boys (the coefficients being +.784 to +.817) with probably a slight decrease to 13 years (+ .738). The maximum coefficient is + .812 at 15 years. The correlations for the girls are different from those for the boys. The coefficient is low at seven years, but increases steadily to + .746 at 13 years. The averages of the coefficients for the ten year period are +.745 for the boys and +.669 for the girls.

(3) *Height-Sitting Height.* In these correlations the sitting height is, of necessity, included in the standing height measures, which probably tends to raise the coefficients. The coefficients show that growth in height bears a closer relation to growth in sitting height for both boys and girls than do any of the other physical traits measured. For the boys there is a decrease in the coefficient from + .963 at seven years to + .783 at 17 years. The coefficients for the girls are irregular from seven to 11 years, + .921 at seven years, + .670 at eight years, + .871 at nine years, + .832 at 10 years. The maximum coefficient is + .933 at 12 years. After this the coefficients are about the same as for boys, falling gradually to + .754 at 17 years. The average coefficient of correlation for the ten-year period is + .901 for boys, and + .858 for girls.

(4) *Height-Girth of Chest.* The coefficients of correlation between the yearly measurements of height and the girth of the chest are lower than the coefficients between height and weight, breathing capacity, and sitting height, but higher than between height and strength of the left arm for both boys and girls. Height correlates higher with girth of the chest than with strength of the right arm or with strength of the upper back, in the case of the boys, but lower in the case of the girls.

The coefficients between height and girth of the chest drop from +.716 at seven years to +.595 at eight years, increase to +.721 at 10 years, drop to + .559 at 13 years, increase to + .756 at 14 years, and then gradually decrease to + .556 at 17 years. The coefficients for girls are + .527 and + .559 at seven and nine years; + .431 at 10 years; + .556 at 12 years and gradually decrease to + .332 at 16 with a slight increase at 17 years. The averages of the coefficients for the ten year period are + .655 for the boys and + .465 for the girls.

TABLE XVI

INTERCORRELATIONS FOR BOYS

The Coefficients of Inter-correlation (Pearson formula, $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}}$ P. E. $= \frac{.6745\ (1-r^2)}{\sqrt{n}}$, for Height, Weight, Breathing Capacity, Sitting Height, Girth of Chest, Strength of Arms and Strength of Upper Back for Boys from Seven to 17 Years of Age.

Age	7		8		9		10		11		12		13		14		15		17		16		
	*Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Coef. ±	P. E.	Av. Coef.
1. Height-Weight	.872	.035	.850	.030	.876	.022	.856	.024	.853	.022	.782	.030	.790	.029	.877	.019	.797	.031	.668	.056	.680	.055	.809
2. Height-Breathing Capacity	.799	.052	.784	.041	.817	.032	.763	.033	.740	.036	.767	.032	.738	.036	.779	.032	.812	.029	.661	.057	.530	.074	.745
3. Height-Sitting Height	.963	.010	.923	.016	.947	.010	.930	.012	.919	.012	.924	.011	.915	.013	.895	.016	.896	.017	.820	.033	.783	.040	.901
4. Height-Girth of Chest	.716	.070	.595	.069	.685	.051	.721	.043	.676	.043	.612	.048	.559	.054	.756	.035	.698	.044	.630	.061	.556	.071	.655
5. Height-Strength Right Arm	.488	.110	.699	.054	.593	.063	.641	.053	.610	.050	.497	.058	.655	.045	.614	.050	.551	.060	.456	.081	.440	.083	.568
6. Height-Strength Left Arm	.375	.124	.532	.077	.633	.058	.547	.063	.565	.055	.443	.062	.579	.052	.672	.044	.527	.062	.425	.083	.384	.088	.517
7. Height-Strength Upper Back	.548	.101	.300	.097	.460	.076	.554	.062	.636	.048	.548	.054	.555	.054	.587	.053	.397	.072	.234	.046	.264	.031	.462
8. Weight-Breathing Capacity	.801	.052	.695	.055	.739	.044	.707	.045	.711	.040	.722	.037	.733	.036	.771	.033	.787	.033	.748	.045	.612	.064	.730
9. Weight-Sitting Height	.833	.045	.800	.038	.858	.025	.818	.030	.808	.028	.739	.035	.791	.029	.837	.024	.784	.033	.759	.043	.607	.065	.785
10. Weight-Girth of Chest	.888	.030	.832	.033	.793	.036	.826	.028	.888	.017	.879	.018	.865	.020	.897	.016	.887	.018	.823	.033	.872	.025	.859
11. Weight-Strength Right Arm	.639	.085	.796	.039	.641	.057	.673	.049	.650	.046	.577	.051	.721	.037	.692	.042	.733	.040	.670	.056	.586	.068	.671
12. Weight-Strength Left Arm	.571	.097	.643	.063	.632	.058	.593	.058	.614	.050	.541	.054	.628	.047	.660	.046	.717	.042	.797	.037	.408	.086	.619
13. Weight-Strength Upper Back	.681	.077	.442	.086	.476	.074	.605	.057	.670	.044	.587	.050	.610	.049	.698	.041	.655	.049	.500	.076	.402	.086	.575
14. Breath. Cap.-Sitting Height	.843	.042	.752	.046	.793	.036	.690	.047	.748	.035	.743	.035	.755	.033	.789	.030	.818	.028	.728	.048	.535	.073	.745
15. Breath. Cap.-Girth of Chest	.768	.059	.621	.066	.643	.057	.667	.050	.650	.046	.732	.036	.712	.038	.715	.039	.740	.039	.704	.051	.634	.062	.690
16. Breath. Cap.-Strength R. Arm	.595	.093	.588	.070	.523	.070	.623	.055	.535	.057	.527	.056	.627	.047	.663	.045	.637	.051	.514	.075	.428	.084	.569
17. Breath. Cap.-Strength L. Arm	.506	.107	.525	.078	.556	.066	.510	.066	.464	.063	.480	.059	.653	.045	.682	.043	.563	.059	.505	.076	.342	.091	.526
18. Breath. Cap.-Strength U. Back	.559	.099	.468	.083	.394	.081	.563	.061	.618	.049	.627	.047	.529	.056	.589	.053	.582	.057	.438	.082	.354	.090	.520
19. Strength R. A.-Strength L. A.	.866	.036	.736	.049	.865	.024	.709	.044	.787	.031	.797	.028	.788	.030	.860	.021	.843	.025	.852	.028	.850	.029	.814

*All of the coefficients of correlations are positive (+) in this section of the Study. These coefficients were worked out in 1917, when the writer was at Johns Hopkins University, where he had the assistance of one of his students, W. F. Shenton.

TABLE XVII

INTERCORRELATIONS FOR GIRLS

The Coefficients of Inter-correlation (Pearson formula, $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \, \Sigma y^2}}$ P. E. $= \frac{.6745\ (1-r^2)}{\sqrt{n}}$, for Height, Weight, Breathing Capacity, Sitting Height, Girth of Chest, Strength of Arms and Strength of Upper Back for Girls from Seven to 17 Years of Age.

Age	7		8		9		10		11		12		13		14		15		16		17		
	*Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Av. Coef.
1. Height-Weight	.559	.092	.636	.070	.638	.063	.638	.056	.581	.050	.693	.041	.645	.047	.666	.045	.542	.061	.486	.070	.547	.071	.603
2. Height-Breathing Capacity	.515	.098	.548	.082	.575	.071	.672	.052	.718	.042	.740	.036	.746	.036	.730	.038	.671	.048	.761	.038	.682	.054	.669
3. Height-Sitting Height	.921	.021	.670	.065	.871	.025	.832	.029	.925	.012	.933	.010	.931	.011	.898	.016	.848	.024	.851	.025	.754	.043	.858
4. Height-Girth Chest	.527	.097	.559	.081	.555	.073	.431	.077	.475	.066	.556	.055	.485	.062	.459	.064	.333	.077	.322	.082	.412	.084	.465
5. Height-Strength Right Arm	.801	.048	.689	.062	.521	.077	.423	.078	.580	.072	.541	.056	.551	.056	.574	.054	.388	.073	.455	.072	.208	.096	.521
6. Height-Strength Left Arm	.793	.049	.654	.067	.455	.084	.396	.080	.458	.068	.500	.060	.524	.059	.387	.069	.338	.077	.242	.085	.137	.099	.444
7. Height-Strength Upper Back	.606	.085	.446	.094	.433	.086	.408	.079	.411	.071	.525	.058	.567	.055	.563	.055	.508	.064	.410	.076	.343	.089	.475
8. Weight-Breathing Capacity	.463	.105	.643	.069	.434	.086	.509	.070	.564	.059	.620	.049	.606	.051	.544	.057	.318	.078	.470	.071	.516	.074	.517
9. Weight-Sitting Height	.505	.100	.482	.090	.638	.063	.618	.058	.646	.050	.691	.042	.657	.046	.692	.042	.516	.063	.512	.067	.510	.074	.588
10. Weight-Girth Chest	.877	.031	.887	.025	.927	.015	.893	.019	.936	.011	.929	.011	.912	.014	.882	.018	.883	.019	.865	.023	.851	.028	.895
11. Weight-Strength Right Arm	.540	.095	.502	.030	.429	.086	.525	.069	.494	.065	.502	.060	.641	.048	.576	.054	.470	.067	.437	.074	.361	.087	.498
12. Weight-Strength Left Arm	.529	.096	.425	.096	.400	.089	.478	.073	.496	.065	.569	.054	.499	.061	.421	.066	.403	.072	.341	.080	.258	.094	.438
13. Weight-Strength Upper Back	.433	.109	.424	.096	.434	.086	.386	.080	.351	.075	.414	.066	.467	.063	.538	.057	.381	.074	.416	.075	.434	.082	.425
14. Breath. Cap.-Sitting Height	.589	.097	.430	.096	.675	.057	.548	.066	697	.044	.590	.052	.762	.034	.696	.042	.614	.054	.688	.048	.654	.058	.631
15. Breath. Cap.-Girth Chest	.536	.095	.717	.057	.419	.087	.450	.075	.473	.067	.506	.059	.540	.057	.492	.061	.490	.066	.443	.073	.439	.081	.500
16. Breath. Cap.-Strength R. Arm	.694	.069	.383	.100	.377	.090	.379	.081	.584	.056	.419	.066	.479	.062	.429	.066	.291	.079	.419	.075	.163	.098	.420
17. Breath. Cap.-Strength L. Arm	.572	.090	.452	.093	.387	.090	.398	.080	.496	.065	.408	.066	.444	.065	.400	.068	.255	.081	.246	.085	.120	.099	.380
18. Breath. Cap.-Strength U. Back	.681	.072	.445	.094	.461	.083	.323	.085	.521	.063	.389	.068	.511	.060	.447	.065	.293	.079	.290	.083	.190	.097	.414
19. Strength R. A.-Strength L. A.	.866	.034	.805	.041	.810	.036	.834	.029	.797	.031	.806	.028	.821	.026	.804	.029	.861	.022	.670	.050	.642	.059	.792

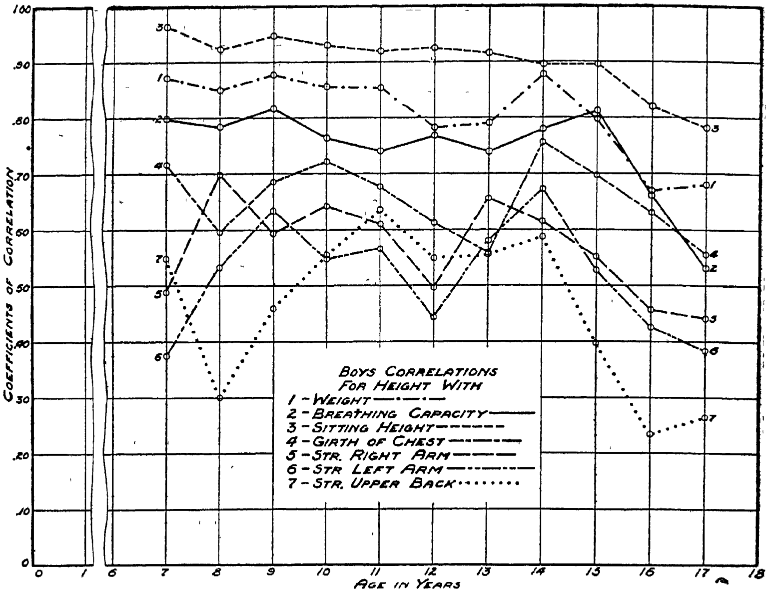


Chart XLV

Chart XLVI

(5 and 6). *Height-Strength of Arm.* For both boys and girls the correlations between the yearly measurements of height and strength of the arm are lower than between height and any of the other physical traits measured except the strength of the upper back.

Height bears about the same relation to strength of the right arm as to strength of the left arm. The correlation is high for boys at eight and nine years, but drops to +.497 for the right arm and + .443 for the left at 12 years. The coefficients increase to + .655 for the right at 13 years and + .672 for the left at 14 years. After that time the correlation coefficients decrease to + .440 and + .384 for left and right arm, respectively, at 17 years. The relation between height and strength of the arm for girls is very irregular. At seven years, the coefficients are + .801 with the right arm and + .793 with the left arm. They decrease to + .423 and + .396 at 10 years, increase again to + .574 for the right arm at 14 years and + .524 for the left at 13 years. They decrease to + .208 and + .137 at 17 years. The averages of the coefficients are: height with right arm + .568 for boys and + .521 for girls and with left arm + .517 for boys and + .444 for girls.

(7) *Height-Strength of Upper Back.* The correlations between the yearly measurements of height and strength of the upper back are lower than the correlations between height and the other six physical traits at all years in the case of the boys and from seven to 11 years in the case of the girls. After 11 years, these correlations for girls are higher than with the strength of the arms and the girth of the chest.

For the boys, the coefficient of correlation is +.300 at eight years, rises to + .636 at 11 years, drops to + .587 at 14 years and drops rapidly to the minimum, + .234 at 16 years. There are no such marked differences in the correlation coefficients of the girls from year to year. The coefficient is + .606 at seven years, decreases to + .408 at 10 years, rises to + .567 at 13 years, and is + .343 at 17 years. The averages of the coefficients are + .462 for boys and + .475 for girls.

(8) *Weight-Breathing Capacity.* The correlations between the yearly measurements of weight and height, sitting height, and girth of chest are higher than with breathing capacity for both boys and girls.

The correlation is highest for the boys at seven years (+.801) and

at eight years (+ .695.) The coefficient gradually increases to +.787 at 15 years and is + .617 at 17 years. The correlation between weight and breathing capacity is not high for girls and there is much wider variation from year to year. The coefficient drops from + .643 at eight years to + .434 at nine years and then gradually increases to the maximum (+ .620) at 12 years. The minimum (+ .318) is reached at 15 years. The averages of the coefficients are + .730 for boys and + .517 for girls.

(9) *Weight-Sitting Height.* The coefficients of correlation between the yearly measurements of weight and sitting height are almost the same as those of weight and height, though slightly lower. They are also lower than the coefficients between weight and the girth of the chest.

With the boys, the coefficient is +.858 at nine years and +.739 at 12 years, + .837 at 14 years, and decreases to + .607 at 17 years. With the girls, the coefficient increases to + .692 at 14 years and then drops to + .510 at 17 years. The averages of the coefficients are + .785 for the boys and + .588 for the girls.

(10) *Weight-Girth of Chest.* Between the yearly measurements of weight and the girth of the chest the correlations are higher than for weight and any other physical trait measured.

The coefficients are fairly uniform throughout the ten years, varying from + .793 at nine years to + .897 at 14 years for the boys and from + .927 at nine years to + .851 at 17 years for the girls. The averages of the coefficients are +.859 for boys and +.895 for girls.

(11 and 12) *Weight-Strength of Arm.* The correlation coefficients between the yearly measurements of weight and strength of the arm are lower than between weight and height, breathing capacity, sitting height and the girth of the chest.

For the boys, the coefficients between weight and strength of the right arm are slightly higher than between weight and strength of the left arm. The coefficients vary from +.796 and +.643 for right and left respectively, at eight years, to + .577 and + .541 at 12 years. The coefficient increases to +.733 (weight with right arm) at 15 and + .797 (weight with left arm) at 16 years and then drops to + .586 and + .408 at 17 years. For the girls, the coefficients vary from +.540 and + .529 at seven years to + .429 and + .400 at nine years, increase to the maximum + .641, at 13 years (right arm) and + .569 at 12 years (left arm), and then

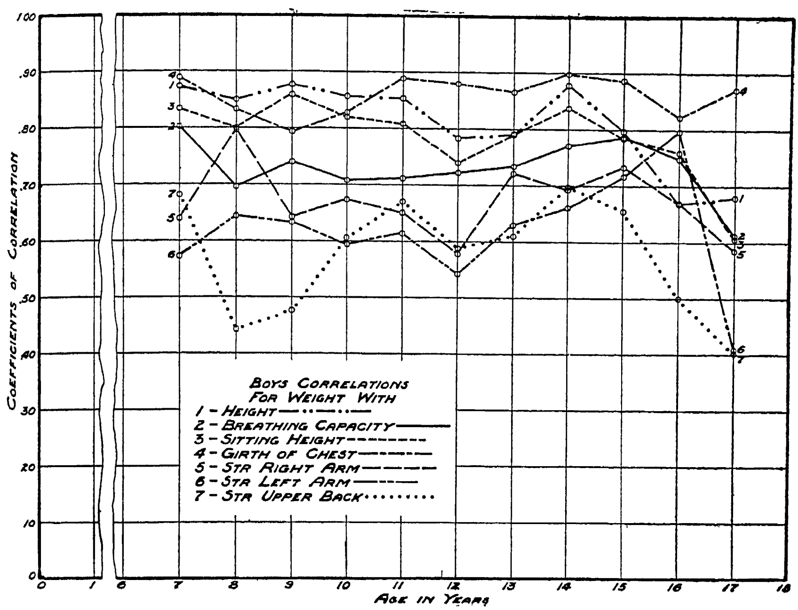


Chart XLVII

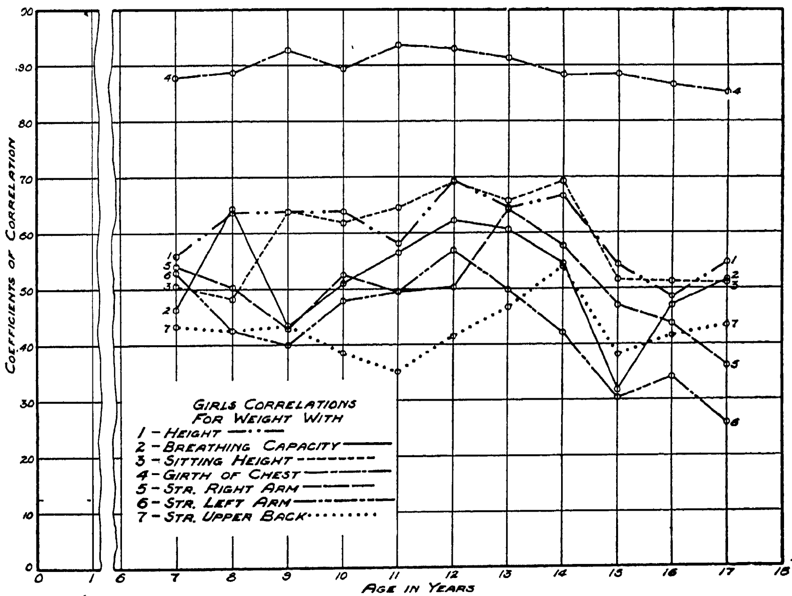


Chart XLVIII

gradually decrease to + .361 and + .258 at 17 years. The averages of the coefficients are: weight with strength of the right arm, +.671 for boys and +.498 for girls, and with strength of the left arm, +.619 for boys and +.438 for girls.

(13) *Weight-Strength of Upper Back.* The coefficients between the yearly measurements of weight and strength of the upper back are lower than any of the other weight correlations.

The coefficient drops from +.681 at seven years to +.442 at eight years, increases at 11 years and decreases again at 12 years. It reaches the maximum + .698 at 14 years and then decreases to + .402 at 17 years. With the girls, the coefficient drops from + .433 at seven years to + .351 at 11 years, then increases to + .538 at 14 years, followed by a decrease. The averages of the coefficients are + .575 for boys and + .425 for girls.

(14) *Breathing Capacity-Sitting Height.* The correlation coefficients between the yearly measurements of breathing capacity and sitting height are very much like those between breathing capacity and standing height, though slightly lower. They are higher than the coefficients of correlation between breathing capacity and the five other physical traits.

For the boys, the coefficient decreases from +.843 at seven years to + .690 at 10 years, increases to + .818 at 15 years and then drops to + .535 at 17 years. For the girls, the coefficients are very irregular, alternately high and low. The maximum coefficient is + .762 at 13 years, and the minimum is + .430 at eight years. The averages of the coefficients are +.745 for boys and +.631 for girls.

(15) *Breathing Capacity-Girth of Chest.* The correlations between the yearly measurements of breathing capacity and girth of the chest are not so high as those between breathing capacity and height, sitting height and weight.

For the boys, the coefficient drops from +.768 at seven years to + .621 at eight years, increases to + .740 at 15 years and then decreases to +. 634 at 17 years. For the girls, the coefficient increases from +.536 at seven years to +.717 at eight years, drops to + .419 at nine years, increases to + .540 at 13 years and then drops to + .439 at 17 years. The averages of the coefficients are +.690 for boys and +.500 for girls.

(16 and 17) *Breathing Capacity-Strength of Arm.* The coefficients of correlation between the yearly measurements of breathing

capacity and the strength of the arm are lower than those between breathing capacity and height, sitting height, weight and girth of the chest.

For boys, the coefficients between breathing capacity and the right and the left arm change from +.595 and +.506 at seven years, to +.523 and +.556 at nine years, increase to +.663 and +.682 at 14 years, then drop to + .428 and + .342 at 17 years. The coefficients are much more irregular from year to year for the

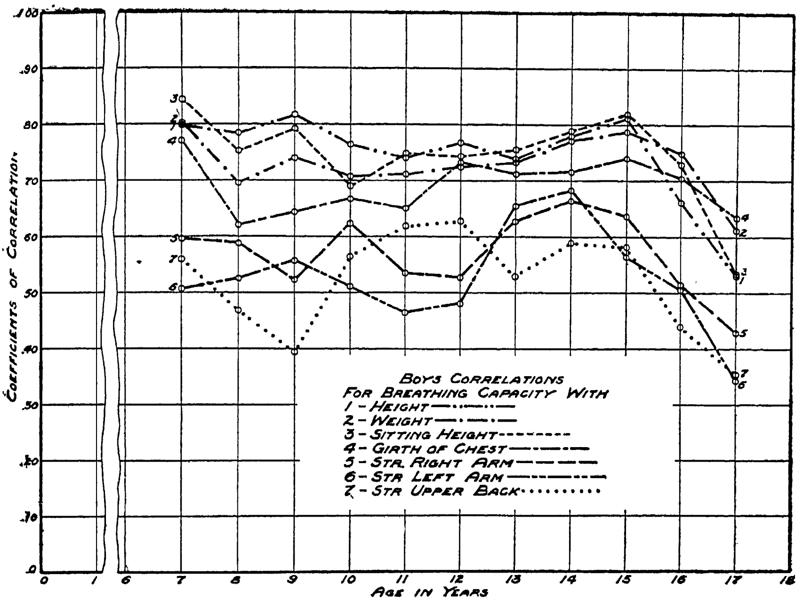


Chart XLIX

girls, alternately high and low. At seven years, the coefficients are +.694 with the strength of the right arm and +.572 with the strength of the left arm. There is very little correlation after 14 years. The coefficients drop to + .163 and + .120 at 17 years. The averages of the coefficients are: breathing capacity with strength of the right arm, + .569 for boys and + .420 for girls; with strength of the left arm, +.526 for boys and +.380 for girls.

(18) *Breathing Capacity-Strength of Upper Back.* The coefficients of correlation between the yearly measurements of breathing capacity and strength of upper back are lower than the correlations of breathing capacity and the other six traits for boys and for girls,

except in the case of breathing capacity and strength of the left arm.

For boys, the coefficient drops from +.559 at seven years to + .394 at nine years, increases to + .627 at 12 years, drops slightly at 13, increases again at 14 and 15, then decreases to + .354 at 17 years. For girls, the coefficient drops from + .681 at seven years to + .190 at 17 years, alternately increasing and decreasing. The averages of the coefficients are + .520 for boys and + .414 for girls.

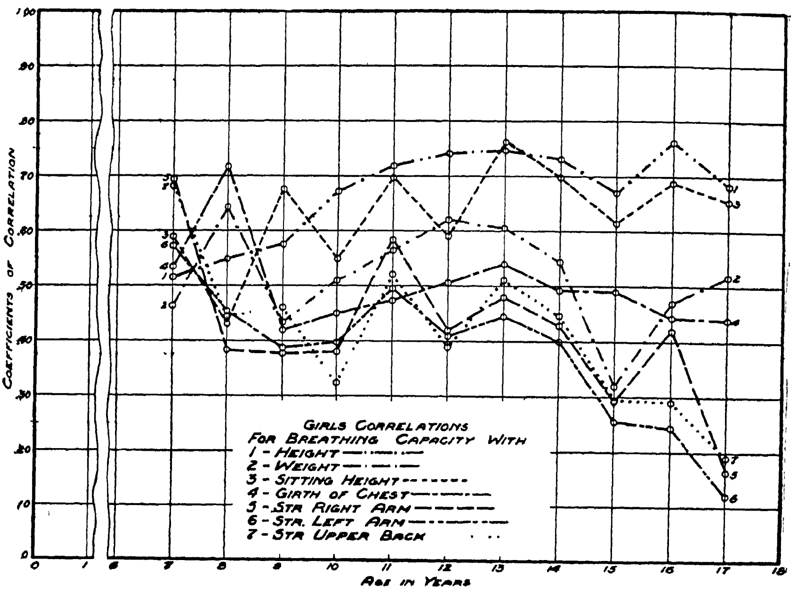


Chart L

(19) *Strength of Right Arm-Strength of Left Arm.* The correlation coefficients between the yearly measurements of strength of the right arm and strength of the left arm are uniformly high for both boys and girls. The averages of the coefficients are +.814 for boys and +.792 for girls.

There is some irregularity from the ages of seven to 11 for both sexes. Between 11 and 13 years, the coefficients are +.787 and +.797 for boys; between 14 and 17 years, they are +.843 and +.860. For girls, the coefficients vary from +.797 to +.821 between 11 and 14 years, increase to +.861 at 15 years and drop to +.642 at 17 years.

B. COLLEGE GIRLS FROM 17 TO 20 YEARS OF AGE

The physical measurements of height, weight and breathing capacity were made on 80 Swarthmore college girls annually for four years. The average height, weight and breathing capacity of the college girls at entrance were about the same as that of the 15 year old girls of the former group, but at the time of entrance to the senior year the college girls did not measure up to the standards of the 16 year old girls of the former group. There was little growth in weight and breathing capacity after the first year. The coefficients of correlation are lower than those of the other groups but follow the same general tendencies.

TABLE XVIII

CORRELATIONS FOR COLLEGE GIRLS IN HEIGHT-WEIGHT, HEIGHT-BREATHING CAPACITY AND WEIGHT-BREATHING CAPACITY

	Freshman 17 yrs.	Sophomore 18 yrs.	Junior 19 yrs.	Senior 20 yrs.
	Coef. P. E.	Coef. P. E.	Coef. P. E.	Coef. P. E.
(1). Height-Weight	+.299±.063	+.358±.066	+.351±.066	+.289±.069
(2). Height-Breathing Capacity	+.425±.062	+.502±.056	+.591±.049	+.607±.048
(3). Weight-Breathing Capacity	+.397±.064	+.389±.064	+.398±.063	+.414±.062

TABLE XIX

COMPARISON OF NORMS FOR THE CORRELATION GROUP OF GIRLS AGES 15, 16 AND 17, WITH 80 SWARTHMORE COLLEGE WOMEN

Traits	Correlation Group, by Ages			College Women, by Classes			
	15	16	17	Freshman	Sophomore	Junior	Senior
Weight	53.40	55.38	55.70	52.96	54.66	54.88	55.07
Height	159.71	161.55	161.75	159.56	160.04	160.33	160.82
Breath. Cap.	28.44	29.92	30.40	27.53	29.04	29.31	29.50
Right arm	30.39	32.29	32.18	24.80	27.04	27.26	28.94

2. ANALYSIS OF CORRELATED TRAITS:

Frequently in total correlations between physical traits, other traits are influential, making the coefficients of correlation higher or lower than they otherwise would be. These extraneous variables

may be brought under control or kept constant by the method of partial correlations. In these partial correlations the third, or constant trait, is enclosed in parentheses and the coefficient is for the other variables. The Kelly tables have been used with the original data and the Pearson formula.*

1. From Table XX it will be observed that the partial coefficients of correlation are lower than the total correlations. For height and weight, with sitting height constant, there is a slight positive correlation, which is relatively uniform with a decrease after 11 years. For height and sitting height, with weight constant, there is a decrease in the correlation, *i. e.*, growth in weight affects but very little the relationship between growth in height and sitting height. Between weight and sitting height, with height constant, there is little or no correlation, with a tendency toward a positive correlation after 11 years of age.

2. For height and weight, with breathing capacity constant, there is a positive correlation, with a decrease with age. When weight is constant, *i. e.*, if children grew tall and thin, the weight remaining the same, the correlation between height and breathing capacity would be comparatively low, (+.35 at seven and +.32 at 16 years of age.) If height remains constant, the correlation between weight and breathing capacity would be low.

3. If the chest girth remains constant, the coefficient between height and weight would still remain high, with a decrease with age, as is true with the correlation between height and weight. If the weight were to remain constant, then the correlation between height and girth of chest is negligible, or nearly 0. If height is constant, the correlation between weight and girth of chest is slightly reduced, but still high.

4. If the strength of the right arm were to remain constant, the correlation between height and weight would remain about the same as with total correlation between height and weight. If the weight were constant, the correlation between height and strength of right arm would be approximately 0. If height were constant, the correlation between weight and strength of right arm is slightly decreased.

5. For height and weight, with strength of left arm constant, the correlation is high, *i. e.* keeping strength of left arm constant has little effect on the relationship between growth in height and weight.

* In this work the writer was assisted by Gladys Fairbanks, A. M.

Table XX

PARTIAL COEFFICIENTS OF CORRELATION

BOYS, BY AGE

	Traits Correlated. (The constant element in each case is enclosed in parentheses)	7	8	9	10	11	12	13	14	15	16	17	Av.
	Height-Weight (Sitting Height)	.466	.482	.399	.460	.455	.373	.262	.526	.362	.127	.422	.394
1	Height-Sitting Height (Weight)	.869	.756	.801	.766	.752	.818	.787	.624	.732	.642	.628	.743
	Weight-Sitting Height (Height)	-.406	.084	.159	.106	.396	.093	.262	.232	.227	.493	.174	.165
	Height-Weight (Breathing Capacity)	.641	.767	.712	.705	.684	.511	.547	.705	.444	.351	.532	.599
2	Height-Breathing Capacity (Weight)	.351	.493	.528	.414	.371	.478	.392	.338	.485	.323	.198	.397
	Weight-Breathing Capacity (Height)	.351	.110	.069	.174	.227	.303	.356	.278	.402	.550	.403	.293
	Height-Weight (Girth Chest)	.724	.788	.752	.675	.731	.649	.743	.692	.543	.345	.473	.646
3	Height-Girth Chest (Weight)	-.240	-.361	-.021	.019	-.321	-.260	-.420	-.155	-.041	.188	-.085	.153
	Weight-Girth Chest (Height)	.768	.757	.533	.592	.809	.818	.843	.750	.767	.695	.809	.740
	Height-Weight (Strength Right Arm)	.828	.674	.808	.753	.753	.697	.605	.797	.697	.551	.580	.704
4	Height-Strength Right Arm (Weight)	-.176	.061	.073	.169	.145	.093	.214	.009	-.082	.023	.066	.054
	Weight-Strength Right Arm (Height)	.499	.546	.317	.305	.318	.348	.430	.409	.582	.551	.442	.431
	Height-Weight (Strength Left Arm)	.863	.788	.803	.792	.775	.715	.671	.782	.712	.605	.625	.739
5	Height-Strength Left Arm (Weight)	-.286	-.035	.204	.105	.126	.036	.173	.248	-.111	-.236	.153	.034
	Weight-Strength Left Arm (Height)	.523	.425	.204	.277	.290	.350	.343	.202	.585	.762	.226	.380
	Height-Weight (Strength Upper Back)	.807	.840	.843	.792	.736	.673	.681	.806	.777	.661	.651	.751
6	Height-Strength Upper Back (Weight)	-.113	-.158	.090	.061	.182	.178	.162	-.076	-.283	-.162	-.017	.012
	Weight-Strength Upper Back (Height)	.490	.368	.178	.324	.311	.306	.331	.473	.619	.477	.314	.381
	Height-Breathing Capacity (Sitting Height)	-.044	.349	.360	.446	.195	.336	.163	.257	.290	.159	.207	.247
7	Height-Sitting Height (Breathing Capacity)	.883	.813	.862	.866	.822	.816	.820	.743	.703	.663	.691	.789
	Breathing Capacity-Sitting Height (Height)	.427	.134	.065	-.068	.260	.127	.298	.326	.354	.442	.236	.236
	Height-Breathing Capacity (Chest Girth)	.556	.648	.682	.538	.539	.602	.584	.518	.606	.393	.273	.539
8	Height-Chest Girth (Breathing Capacity)	.270	.239	.373	.435	.392	.108	.072	.455	.258	.311	.344	.296
	Breathing Capacity-Chest Girth (Height)	.465	.305	.177	.274	.299	.516	.527	.314	.415	.484	.472	.386
	Height-Breathing Capacity (Strength R. Arm)	.722	.633	.744	.603	.616	.686	.553	.634	.715	.557	.419	.625
9	Height-Strength R. Arm (Breathing Capacity)	.019	.475	.337	.330	.374	.171	.368	.204	.071	.192	.279	.256
	Breathing Capacity-Strength R. Arm (Height)	.397	.100	.076	.266	.168	.263	.281	.374	.396	.310	.257	.262
	Height-Breathing Capacity (Strength L. Arm)	.764	.694	.723	.666	.654	.710	.590	.598	.728	.569	.461	.650
10	Height-Strength L. Arm (Breathing Capacity)	-.053	.217	.411	.291	.382	.127	.196	.305	.158	.146	.249	.220
	Breathing Capacity-Strength L. Arm (Height)	.370	.217	.098	.168	.069	.249	.406	.337	.262	.331	.179	.244
	Height-Breathing Capacity (Strength U. Back)	.715	.762	.781	.657	.570	.652	.628	.659	.775	.643	.488	.666
11	Height-Strength U. Back (Breathing Capacity)	.204	-.121	.267	.233	.342	.132	.292	.257	.147	-.090	.094	.159
	Breathing Capacity-Strength U. Back (Height)	.242	.398	.026	.260	.286	.390	.205	.257	.476	.395	.259	.290
	Weight-Breathing Capacity (Sitting Height)	.336	.252	.196	.345	.266	.381	.326	.232	.418	.439	.421	.336
12	Weight-Sitting Height (Breathing Capacity)	.484	.585	.672	.646	.598	.442	.529	.595	.377	.468	.421	.528
	Breathing Capacity-Sitting Height (Weight)	.527	.441	.445	.267	.423	.442	.440	.415	.534	.375	.266	.416

13	Weight-Breathing Capacity (Chest Girth)	.396	.427	.496	.375	.382	.239	.323	.407	.428	.433	.161	.369
	Weight-Chest Girth (Breathing Capacity)	.714	.711	.616	.675	.802	.749	.733	.782	.745	.627	.794	.722
	Breathing Capacity-Chest Girth (Weight)	.216	.098	.138	.202	.054	.290	.224	.100	.134	.224	.254	.175
14	Weight-Breathing Capacity (Strength R. Arm)	.679	.468	.618	.508	.558	.599	.516	.579	.611	.642	.488	.569
	Weight-Strength R. Arm (Breathing Capacity)	.331	.668	.444	.416	.452	.338	.487	.382	.474	.507	.459	.450
	Breathing Capacity-Strength R. Arm (Weight)	.192	.068	.092	.274	.147	.199	.221	.282	.153	.017	.108	.159
15	Weight-Breathing Capacity (Strength L. Arm)	.725	.558	.599	.589	.609	.621	.540	.587	.673	.664	.551	.610
	Weight-Strength L. Arm (Breathing Capacity)	.325	.443	.384	.375	.454	.318	.302	.293	.548	.736	.271	.404
	Breathing Capacity-Strength L. Arm (Weight)	.110	.148	.177	.161	.047	.155	.356	.361	—.021	—.227	.123	.126
16	Weight-Breathing Capacity (Strength U. Back)	.693	.621	.686	.559	.508	.559	.607	.616	.662	.685	.551	.613
	Weight-Strength U. Back (Breathing Capacity)	.466	.178	.312	.362	.416	.256	.388	.476	.403	.284	.252	.344
	Breathing Capacity-Strength U. Back (Weight)	.035	.253	.061	.226	.274	.370	.158	.115	.127	.115	.147	.171
17	Strength R. Arm-Strength L. Arm (Height)	.848	.608	.799	.559	.683	.749	.662	.767	.773	.816	.819	.734
	Height-Strength L. Arm (Strength R. Arm)	—.107	.024	.292	.178	.182	.079	.127	.358	.152	.084	.011	.125
	Height-Strength R. Arm (Strength L. Arm)	.347	.537	.108	.424	.320	.277	.403	.089	.226	.198	.239	.228
18	Strength R. Arm-Strength L. Arm (Weight)	.797	.495	.786	.526	.653	.711	.628	.745	.664	.709	.828	.685
	Weight-Strength L. Arm (Strength R. Arm)	.035	.120	.194	.217	.209	.158	.144	.182	.290	.592	—.216	.175
	Weight-Strength R. Arm (Strength L. Arm)	.357	.636	.239	.443	.347	.293	.467	.320	.336	—.034	.502	.355
19	Strength R. Arm-Strength L. Arm (Breath. Cap.)	.817	.624	.815	.582	.726	.730	.641	.750	.756	.396	.831	.697
	Breath. Cap.-Strength L. Arm (Strength R. Arm)	—.022	.171	.253	.126	.066	.112	.320	.294	.055	.170	—.055	.135
	Breath. Cap.-Strength R. Arm (Strength L. Arm)	.370	.345	.081	.425	.326	.277	.252	.199	.381	.170	.285	.282

TABLE XXI

PARTIAL COEFFICIENTS OF CORRELATION

GIRLS, BY AGES

	Traits Correlated. (The constant element in each case is enclosed in parentheses)	7	8	9	10	11	12	13	14	15	16	17	Av.
1	Height-Weight (Sitting Height)	—.289	.492	.220	.290	—.088	.183	.130	.156	.217	.126	.296	.157
	Height-Sitting Height (Weight)	.887	.536	.777	.720	.898	.868	.876	.814	.791	.797	.652	.622
	Weight-Sitting Height (Height)	—.016	.088	.220	.205	370	.182	.199	.269	.140	.205	.176	.177
2	Height-Weight (Breathing Capacity)	.424	.450	.531	.470	.308	.437	.369	.481	.462	.230	.315	.407
	Height-Breathing Capacity (Weight)	.357	.236	.439	.518	.584	.549	.587	.589	.621	.689	.551	.519
	Weight-Breathing Capacity (Height)	.237	.450	.095	.141	.269	.222	.244	.100	—.067	.175	.237	.191
3	Height-Weight (Girth Chest)	.231	.377	.389	.626	.430	.553	.567	.628	.557	.453	.419	.475
	Height-Girth Chest (Weight)	.094	—.030	—.125	—.400	—.234	—.306	—.324	—.366	—.364	—.246	—.132	—.221
	Weight-Girth Chest (Height)	.827	.834	.897	.885	.926	.909	.893	.870	.885	.863	.818	.873
4	Height-Weight (Strength Right Arm)	.253	.474	.542	.543	.418	.575	.466	.504	.439	.359	.522	.463
	Height-Strength Right Arm (Weight)	.710	.554	.352	.126	.418	.314	.228	.298	.185	.318	.015	.319
	Weight-Strength Right Arm (Height)	.184	.106	.147	.372	.233	.208	.448	.325	.335	.276	.301	.266
5	Height-Weight (Strength Left Arm)	.232	.527	.561	.555	.455	.572	.526	.608	.469	.450	.549	.500
	Height-Strength Left Arm (Weight)	.699	.539	.290	.136	.242	.179	.297	.160	.162	.090	—.004	.253
	Weight-Strength Left Arm (Height)	.212	.023	.157	.318	.321	.362	.250	.231	.272	.262	.222	.239

	Height-Weight (Strength Upper Back)	.417	.554	.560	.571	.511	.609	.531	.525	.437	.385	.477	.507
6	Height-Strength Upper Back (Weight)	.496	.258	.223	.225	.271	.377	.401	.317	.389	.256	.139	.304
	Weight-Strength Upper Back (Height)	.133	.194	.223	.183	.152	.073	.143	.270	.144	.277	.308	.191
	Height-Breathing Capacity (Sitting Height)	-.072	.390	-.030	.461	.263	.645	.184	.319	.366	.453	.383	.304
7	Height-Sitting Height (Breathing Capacity)	.889	.578	.793	.742	.862	.907	.841	.798	.750	.696	.557	.764
	Breathing Capacity-Sitting Height (Height)	.335	.098	.437	-.012	.119	-.394	.255	.147	.105	.128	.287	.137
	Height-Breathing Capacity (Chest Girth)	.327	.256	.459	.591	.638	.635	.659	.651	.621	.731	.609	.561
8	Height-Chest Girth (Breathing Capacity)	.346	.285	.427	.195	.230	.317	.155	.172	.004	-.026	.169	.206
	Breathing Capacity-Chest Girth (Height)	.365	.599	.140	.241	.203	.169	.297	.255	.385	.318	.243	.292
	Height-Breathing Capacity (Strength R. Arm)	-.075	.428	.487	.607	.580	.673	.667	.655	.636	.703	.672	.548
9	Height-Strength R. Arm (Breathing Capacity)	.716	.626	.399	.242	.288	.376	.326	.415	.276	.241	.140	.367
	Breathing Capacity-Strength R. Arm (Height)	.534	-.001	.114	.145	.288	.038	.122	.024	.041	.121	.025	.132
	Height-Breathing Capacity (Strength L. Arm)	.141	.378	.488	.607	.637	.680	.677	.684	.640	.742	.677	.577
10	Height-Strength L. Arm (Breathing Capacity)	.707	.539	.310	.194	.165	.321	.318	.158	.233	.080	.080	.282
	Breathing Capacity-Strength L. Arm (Height)	.304	.148	.169	.194	.273	.070	.089	.184	.046	.108	.035	.147
	Height-Breathing Capacity (Strength U. Back)	.180	.434	.478	.625	.648	.683	.655	.645	.638	.738	.664	.580
11	Height-Strength U. Back (Breathing Capacity)	.411	.271	.225	.277	.061	.393	.331	.380	.446	.306	.293	.308
	Breathing Capacity-Strength U. Back (Height)	.538	.271	.287	.068	.355	-.005	.152	.075	-.080	-.036	-.060	.143
	Weight-Breathing Capacity (Sitting Height)	.229	.546	-.007	.260	.192	.364	.223	.113	.005	.192	.288	.217
12	Weight-Sitting Height (Breathing Capacity)	.336	.295	.525	.471	.436	.513	.380	.517	.436	.293	.265	.406
	Breathing Capacity-Sitting Height (Weight)	.466	.181	.583	.346	.535	.285	.601	.536	.550	.595	.523	.472
	Weight-Breathing Capacity (Chest Girth)	.039	-.003	.119	.271	.392	.459	.343	.265	-.267	.198	.307	.241
13	Weight-Chest Girth (Breathing Capacity)	.935	.809	.914	.858	.928	.908	.871	.836	.875	.835	.807	.870
	Breathing Capacity-Chest Girth (Weight)	.320	.426	.059	-.010	-.199	-.230	-.048	.036	.462	.073	-.006	.080
	Weight-Breathing Capacity (Strength R. Arm)	.143	.563	.320	.396	.389	.520	.447	.395	.216	.351	.504	.385
14	Weight-Strength R. Arm (Breathing Capacity)	.349	.363	.320	.424	.244	.334	.500	.460	.415	.304	.330	.367
	Breathing Capacity-Strength R. Arm (Weight)	.592	.089	.241	.150	.426	.161	.146	.171	.168	.268	-.033	.216
	Weight-Breathing Capacity (Strength L. Arm)	.229	.554	.327	.394	.412	.513	.504	.446	.244	.424	.508	.414
15	Weight-Strength L. Arm (Breathing Capacity)	.367	.208	.278	.351	.305	.443	.328	.266	.345	.260	.233	.307
	Breathing Capacity-Strength L. Arm (Weight)	.434	.251	.264	.208	.305	.087	.198	.227	.152	.110	-.019	.201
	Weight-Breathing Capacity (Strength U. Back)	.253	.554	.291	.443	.473	.547	.492	.395	.237	.400	.495	.416
16	Weight-Strength U. Back (Breathing Capacity)	.182	.194	.291	.279	.082	.231	.220	.395	.316	.334	.394	.265
	Breathing Capacity-Strength U. Back (Weight)	.603	.258	.339	.152	.418	.191	.325	.223	.192	.116	-.043	.252
	Strength R. Arm-Strength L. Arm (Height)	.648	.658	.754	.794	.735	.739	.747	.762	.845	.649	.629	.723
17	Height-Strength L. Arm (Strength R. Arm)	.317	.217	.079	.103	-.006	.129	.143	-.171	.010	-.103	.007	.066
	Height-Strength R. Arm (Strength L. Arm)	.274	.364	.283	.174	.400	.266	.255	.467	.202	.416	.159	.296
	Strength R. Arm-Strength L. Arm (Weight)	.817	.762	.772	.770	.739	.742	.749	.751	.834	.614	.607	.741
18	Weight-Strength L. Arm (Strength R. Arm)	.145	.050	.098	.083	.206	.326	-.058	-.088	-.009	.068	.043	.078
	Weight-Strength R. Arm (Strength L. Arm)	.138	.287	.197	.267	.176	.082	.466	.450	.270	.303	.262	.268
	Strength R. Arm-Strength L. Arm (Breath. Cap.)	.800	.773	.774	.800	.725	.772	.773	.760	.847	.644	.633	.754
19	Breath. Cap.-Strength L. Arm (Strength R. Arm)	-.086	.261	.150	.165	.076	.132	.092	.105	.022	-.048	.023	.081
	Breath. Cap.-Strength R. Arm (Strength L. Arm)	.480	.030	.118	.095	.350	.165	.234	.201	.135	.351	.109	.206

With height constant the correlation between height and strength of left arm is negligible, or nearly 0. With height constant, the relationship between weight and strength of left arm is little affected.

6. The correlation between height and weight is little affected when the strength of upper back is kept constant. With weight kept constant, the correlation between height and strength of upper back is approximately 0, *i. e.* the growth in height independent of weight has little to do with growth in the strength of upper back. With height constant there is a higher coefficient, but not as high as the total correlation between weight and strength of upper back.

7. With sitting height constant, the relation between height and breathing capacity is decidedly lower than in the total correlation, which shows that the growth in sitting height is more closely correlated with growth in breathing capacity than is the case with growth in height. If breathing capacity is constant, there is little effect on the correlation between height and sitting height. If height is constant, the correlation between breathing capacity and sitting height is greatly reduced.

8. If chest girth is constant, the correlation between height and breathing capacity is slightly reduced. If breathing capacity is constant, the correlation between height and chest girth is considerably reduced. If height is constant, the correlation between breathing capacity and chest girth is considerably reduced.

9. When strength of right arm is constant, there is little effect on correlation between height and breathing capacity. With breathing capacity constant, the correlation between height and strength of right arm is greatly reduced. When height is constant, the correlation between breathing capacity and strength of right arm is also considerably reduced.

10. When strength of left arm is kept constant, the correlation between height and breathing capacity is reduced practically to 0, the strength tests having little effect on the correlations between other traits. With breathing capacity constant, the correlation between height and strength of left arm is reduced considerably. When height is constant, the correlation between breathing capacity and strength of left arm is greatly reduced.

11. When strength of upper back remains constant, the correlation between height and breathing capacity is unaffected. With breathing capacity constant, the correlation between height and

strength of upper back is greatly reduced. When height is constant, breathing and strength of upper back have a much lower coefficient of correlation.

12. When sitting height is constant, the correlation between height and breathing capacity is greatly reduced. When breathing capacity is constant, the correlation between weight and sitting height is somewhat reduced. When weight is constant, the correlation between breathing capacity and sitting height is somewhat reduced, also.

13. When chest girth is kept constant, weight and breathing capacity show a considerably lower correlation. With breathing capacity constant, the correlation between weight and girth of chest is very little affected. When weight is constant the relation between breathing capacity and girth of chest is considerably reduced.

14. With strength of right arm constant, the correlation between weight and breathing capacity is very little affected, being slightly reduced. If breathing capacity is constant, weight and strength of right arm show a lower correlation. When weight is constant, breathing capacity and strength of right arm show a much lower correlation.

15. Keeping strength of left arm constant, the correlation between weight and breathing capacity becomes slightly reduced. When breathing capacity remains constant, the correlation between weight and strength of left arm is somewhat reduced, especially in the earlier ages. When weight is constant, the correlation between breathing capacity and strength of left arm is much reduced.

16. If strength of upper back remains constant, the correlation between weight and breathing capacity is somewhat reduced. When breathing capacity is kept constant, the correlation between weight and strength of upper back is also slightly reduced. When weight is constant, the correlation between breathing capacity and strength of upper back is greatly reduced.

17. With height constant, the correlation between strength of right arm and strength of left arm is little affected, *i. e.* growth in height has little influence on the relationship between strength of right arm and left arm. If strength of right arm is constant, the relation between height and strength of left arm is considerably reduced. If strength of left arm is constant, the relation between height and strength of right arm is slightly reduced.

18. When weight is kept constant, the correlation between

TABLE XXII

AVERAGE PARTIAL CORRELATIONS FOR BOYS AND GIRLS FROM SEVEN TO 17 YEARS OF AGE

TRAITS		CONSTANTS: Average Total Correlation	Height	Weight	Breathing Capacity	Sitting Height	Girth of Chest	Strength Right Arm	Strength Left Arm	Strength Upper Back
1. HEIGHT:										
Weight	Boys	.809			.599	.394	.646	.704	.739	.751
	Girls	.603			.407	.157	.475	.463	.500	.507
Breathing Capacity	Boys	.745		.397		.247	.539	.625	.650	.666
	Girls	.669		.519		.304	.561	.548	.577	.580
Sitting Height	Boys	.901		.743	.789					
	Girls	.858		.622	.764					
Girth of Chest	Boys	.655		—.153	.296					
	Girls	.465		—.221	.206					
Strength Right Arm	Boys	.568		.054	.256				.288	
	Girls	.521		.319	.367				.296	
Strength Left Arm	Boys	.517		.034	.220			.125		
	Girls	.444		.253	.282			.066		
Strength Upper Back	Boys	.462		—.012	.159					
	Girls	.475		.304	.308					
2. WEIGHT:										
Breathing Capacity	Boys	.730	.293			.336	.369	.569	.610	.613
	Girls	.517	.191			.217	.241	.385	.414	.416
Sitting Height	Boys	.785	.165		.528					
	Girls	.588	.177		.406					
Chest Girth	Boys	.859	.740		.722					
	Girls	.895	.873		.870					
Strength Right Arm	Boys	.671	.431		.450				.355	
	Girls	.498	.266		.367				.268	
Strength Left Arm	Boys	.619	.380		.404			.175		
	Girls	.438	.239		.307			.078		
Strength Upper Back	Boys	.575	.381		.344					
	Girls	.425	.191		.265					
3. BREATHING CAPACITY:										
Sitting Height	Boys	.745	.236	.416						
	Girls	.631	.137	.472						
Chest Girth	Boys	.690	.386	.175						
	Girls	.500	.292	.080						
Strength Right Arm	Boys	.569	.262	.159					.282	
	Girls	.420	.132	.216					.206	
Strength Left Arm	Boys	.526	.244	.126				—.135		
	Girls	.380	.147	.201				.081		
Strength Upper Back	Boys	.520	.290	.171						
	Girls	.414	.143	.252						
4. STRENGTH RIGHT ARM:										
Strength Left Arm	Boys	.814	.734	.685	.697					
	Girls	.792	.723	.741	.754					

strength of right arm and strength of left arm is little affected. When strength of right arm is constant, the relation between weight and strength of left arm is much reduced. When strength of left arm is constant, the relation between weight and strength of right arm is somewhat reduced.

19. When breathing capacity is kept constant, the correlation between strength of right arm and left arm is slightly reduced. If strength of right arm is kept constant, the relation between breathing capacity and strength of left arm is greatly reduced, almost to 0. If strength of left arm is kept constant, the relation between breathing capacity and strength of right arm is somewhat reduced.

3. Conclusions

I. Of the nineteen relationships between measurements of total growth from the years seven to 17 (in height, weight, and breathing capacity) and the measurements of growth of parts (in sitting height, girth of chest, strength of right arm, left arm and upper back) the correlation coefficients are higher for boys than for girls. The only exception is the correlation between development in weight and girth of chest, where there is involved a distinct anatomical factor.

II. It will also be noted that boys not only grow very differently from girls, but that their development is decidedly more highly correlated in its varied aspects. There is a biological difference between the growth of boys and girls during these ages from seven to 17.

III. All coefficients are positive and tend to be highest during early adolescence and lowest at 17 years of age. The periods of irregular development for *individual* boys and girls are from seven to 10 years of age and during later adolescence. There is a wide range of individual differences among the boys, but a decidedly less constant and unified development among the girls. The analysis and interpretation of the growth of each series of inter-related physical traits is shown by the tabulated and graphic distribution, and the correlation coefficients give a new insight into the development of the human organism during the plastic period from childhood through adolescence.

IV. Because boys and girls show a wider range of individual distribution and because boys and girls differ more in growth from each other at the adolescent period, it has been concluded

that this is a period of irregular individual growth. The consecutive intercorrelations of the various physical traits for both sexes show this to be unfounded. The coefficients of correlation are highest during early adolescence and begin to decrease after 14 years of age.

V. The correlation coefficients expressing on the average the physical development relationship for the period from seven to 17 years of age for boys and girls rank in the following order, from highest to lowest:

Boys Rank	Girls Rank	
1	2	Height-sitting height
2	1	Weight-girth of chest
3	3	Strength of right arm-strength of left arm
4	6	Height-weight
5	7	Weight-sitting height
6	4	Height-breathing capacity
7	5	Breathing capacity-sitting height
8	9	Weight-breathing capacity
9	10	Breathing capacity-girth of chest
10	11	Weight-strength of right arm
11	13	Height-girth of chest
12	15	Weight-strength of left arm
13	16	Weight-strength of upper back
14	17	Breathing capacity-strength of right arm
15	8	Height-strength of right arm
16	19	Breathing capacity-strength of left arm
17	18	Breathing capacity-strength of upper back
18	14	Height-strength of left arm
19	12	Height-strength of upper back

VI. College girls who have had the benefit of physical training show an increase in correlated development in height and breathing capacity from the freshman to the senior year. This is due in part probably to the systematic training and athletics in which these girls participated. The coefficients are lower for college girls than for school girls.

VII. Pearson found "that as far as the correlation between weight and height is concerned, men start with a scarcely sensible advantage over women as infants and conclude as adults with an immensely less correlation than women, among whom it appears to have slightly increased, or at any rate not to have decreased." These results of consecutive measurements for eight years or more give:

Coefficients for seven year old boys +.872 and girls +.559
Coefficient for 17 year old boys +.680 and girls +.547.

The specific conclusions derived from the partial correlations are outlined on pages 137 to 139. The general conclusions are:

VIII. Growth in weight for boys and girls has little effect on growth in height and sitting height, but does materially affect the growth of girth of chest, and also the development of strength, especially for boys.

IX. Growth in height for boys and girls has little effect on the growth of circumference of chest, but does materially affect growth in weight, sitting height and development of strength, especially for the girls.

X. Growth in breathing capacity has a decided effect on the growth of the other traits except sitting height.

4. Practical Applications

It is not the purpose of this section of the scientific *Study* to attempt to indicate many practical applications. These will follow in abundance after the fundamental principles of growth have been formulated and studied, but a few obvious educational corollaries may be cited from the preceding basic conclusions:

(1) Since girls and boys show inherent sex differences in total and partial growth, and in the relationships of these at all ages from seven to 18, girls should have different forms of physical training and different forms of directed play from boys;

(2) A careful analytic study of the periods of growth of boys and girls should precede any provisions for their physical education, and the results of such study will throw light on their development in general motor coördination, and in the mental traits which accompany, directly and indirectly, rhythmic or irregular physical development;

(3) There should be a graduated series of adjustable school desks in accordance with the general laws of physical development and individual differences in boys and girls.

5. Studies in Correlations for Individual Boys and Girls

After answering the question of how the physical traits correlate with each other from year to year as shown by repeated measurements on the same individuals, the problem arises, What correlations exist during the development of an individual? What are the sex differences?

TABLE XXIII

COEFFICIENTS OF CORRELATION

Coefficients of Correlation Based on 11 Consecutive Measurements Taken during the Period from 10-15 Years of Age for Height and Weight with Eight Other Anthropometric Traits of Six Boys and Six Girls.*

Spearman formula: $r = 1 - \frac{6 \Sigma g}{n^2 - 1}$

	Six Boys						Six Girls						Ranking Order	
Standing Height and	I	II	III	IV	V	VI	I	II	III	IV	V	VI	Boys	Girls
Sitting Height	1.00	1.00	.94	1.00	.90	1.00	1.00	1.00	1.00	1.00	1.00	.93	1	1
Weight	.95	1.00	.88	1.00	.90	.88	1.00	1.00	.98	1.00	.71	.78	2	3
Lung Capacity	.78	.95	.79	.94	.71	.82	.85	.98	.98	.91	.62	.70	4	4
Girth Chest	.80	.90	.76	.73	.81	.70	.93	.80	1.00	.58	.62	.53	5	6
Girth Hips	.85	1.00	.88	.88	1.00	.88	1.00	1.00	.98	1.00	.90	.85	3	2
Girth Thigh	.80	.89	.82	.94	.43	.76	.85	.90	.90	1.00	.43	.70	6	5
Girth Upper Arm	.75	.15	.73	.82	.86	.76	.70	.68	.85	.94	.43	.43	8	8
Breadth Shoulders	.45	.81	.82	.94	.71	.76	.33	.80	.68	.91	.71	.80	7	7

	Six Boys						Six Girls						Ranking Order	
Weight and	I	II	III	IV	V	VI	I	II	III	IV	V	VI	Boys	Girls
Standing Height	.95	1.00	.88	1.00	.90	.88	1.00	1.00	.98	1.00	.71	.78	1.5	3
Sitting Height	.95	1.00	.94	1.00	.81	.88	1.00	1.00	.98	1.00	.71	.80	3	2
Lung Capacity	.73	.95	.67	.94	.62	.82	.85	.98	.95	.91	.52	.70	6	5
Girth Chest	.75	.90	.82	.73	.90	.76	.93	.80	.98	.58	.90	.70	5	6
Girth Hips	.85	1.00	1.00	.88	1.00	.88	1.00	1.00	1.00	1.00	.81	.93	1.5	1
Girth Thigh	.80	.89	.94	.94	.52	.88	.85	.90	.93	1.00	.62	.88	4	4
Girth Upper Arm	.75	.15	.73	.82	.76	.64	.70	.68	.88	.94	.52	.60	8	8
Breadth Shoulders	.45	.81	.76	.94	.62	.79	.33	.80	.65	.91	1.00	.83	7	7

*Washington Friends' School

a. *Type Cases.* In order to determine what the individual coefficients (self correlations) are and in order to find out whether or not this is a profitable field for inquiry, six boys and six girls from the Washington Friends' School, who have been measured consecutively from eight to eleven times between the ages of ten and 15 have been selected and the coefficients between height and weight and seven other traits have been found by the Spearman formula.

b. *Conclusions*

I. The results show that: From 10 to 15 years of age for both boys and girls there are very high positive correlations between growth in height and weight and growth in sitting height, girth of chest, girth of hips, girth of thigh, girth of upper arm, breadth of shoulders and lung capacity.

II. Standing height correlates highest with sitting height for both boys and girls.

III. Weight correlates highest with standing height and girth of hips for boys and with girth of hips for girls.

IV. Standing height and weight correlate lowest with the girth of upper arm for both boys and girls.

c. *Applications.* These coefficients for growth give a synoptic picture of how individuals vary in growth from 10 to 15 years of age, and show the need of a series of norms for all ages which the writer is now working out. This group of twelve children represent rather irregular development, due to racial, social, nutritional, educational and sex conditions.

6. Correlations Between Physical Measurements at Nine or 10 Years of Age and Six Years Later

This group of correlations was made in order to determine whether children maintain their relative positions in growth, especially before and after pubescence.

a. *Type Cases.* The four traits of growth in height, weight, breathing capacity and strength (of right arm) have been chosen as indicative of general growth of 138 type cases. Is the short child at nine or 10 still a short child after six years, when growth has largely been completed? Is the relative status of the other physical traits unchanged after six years of growth? The high correlations (self correlations) provide an affirmative answer to these questions.

TABLE XXIV

CORRELATIONS BETWEEN PHYSICAL MEASUREMENTS AT SIX YEARS OF AGE AND SIX YEARS LATER

		No. of cases	Correlation Coefficient	Rank Method	Mean at Age 6	Mean at Age 12	Standard Dev at Age 6	Standard Dev at Age 12
Height in centimeters	Boys	36	.728±.053	.85	117.81	149.01	5.19	9.18
	Girls	77	.807±.027	.82	116.95	150.53	4.59	6.47
Weight in kilograms	Boys	36	.821±.037	.79	21.51	39.74	2.97	7.57
	Girls	77	.779±.030	.79	20.82	41.42	2.68	7.45
Breathing Capacity in deciliters	Boys	36	.572±.076	.52	12.00	24.12	2.44	4.44
	Girls	77	.468±.060	.46	10.72	22.66	2.02	3.10
Strength of Right Arm in kilograms	Boys	36	.585±.074	.60	11.38	25.62	2.92	5.11
	Girls	77	.268±.071	.25	10.73	24.19	2.20	3.96

TABLE XXV

CORRELATIONS BETWEEN PHYSICAL MEASUREMENTS AT NINE AND 10 YEARS OF AGE AND SIX YEARS LATER

		No. of cases	Correlation Coefficient	Mean at 9 or 10 yrs.	Mean 6 yrs. later	Standard Dev. at 9 or 10 yrs.	Standard Dev. 6 yrs. later
Height in centimeters	Boys	44	.921±.015	136.50	168.82	8.04	9.40
	Girls	94	.718±.034	134.90	160.50	5.93	6.14
Weight in kilograms	Boys	44	.817±.034	30.27	56.66	5.33	9.16
	Girls	94	.623±.043	30.35	53.94	5.40	7.29
Breathing Capacity deciliters	Boys	41	.816±.035	18.72	37.99	3.29	8.27
	Girls	92	.725±.033	16.64	28.91	2.17	4.54
Strength of Right Arm kilograms	Boys	44	.647±.059	20.27	44.09	4.27	9.96
	Girls	90	.448±.057	17.22	34.47	2.83	4.76

b. *Conclusions*

I. There is a high correlation between boys' and girls' height at six years of age and six years later, with little sex difference and also between nine or 10 and six year later, with higher coefficients for the boys.

II. The coefficients show that there is a great probability that a tall boy or girl at six years of age will be a tall boy or girl at 12 years of age; a tall boy or girl at nine or 10 will be tall at 15 or 16 years of age, *i. e.* under the conditions obtaining in the first group studied, the height of the boys or girls may be predicted at the age of 12 from the height at six years of age by a regression formula with a probable error of estimate of from three to four centimeters.

III. The heavy boy or girl at six or at nine or 10 will be a heavy boy or girl six years later, and the boy or girl with a large breathing capacity at six or at nine or 10 will have a large breathing capacity six years later; while this is also highly probable with girls, there is a greater chance for variation than with boys. It is apparent that other factors enter into the development of strength. Boys have higher coefficients of correlation except for height at six and 12 years of age.

IV. For the periods at the beginning and end of the selected intervals the boys are superior to the girls in actual measurements, but for other ages within the interim the girls are superior to the boys. The growth curves of girls cross those of boys, but this does not change the relative position of an individual within his or her group.

V. The standard deviations increase with age.

c. *Applications.* These coefficients have direct application to anticipating child development from the physical, mental or social point of view, for they show that one can prophesy with a considerable degree of accuracy the physical development of a boy or girl at 16 years of age, providing the development is known at 10 years of age, and at 12 years of age, providing the development is measured at six years of age. His or her future development correlates highly with his or her earlier development after six years of age in a graded series from development in height to development in strength. These results apply directly to vocational guidance, school training, social activities and periods of maturation.

TABLE XXVI

COEFFICIENT OF VARIATION = $100 \frac{\sigma}{m}$

For Eight Physical Traits from Seven to 17 Years of Age. Boys. Girls.

			7	8	9	10	11	12	13	14	15	16	17
Height	Cms.	Boys	5.923	4.932	5.669	5.388	5.242	4.929	5.166	5.796	5.273	4.408	3.933
		Girls	4.248	4.107	4.259	4.650	5.122	5.426	5.141	4.871	4.320	4.209	4.080
Weight	Kgms.	Boys	17.529	13.776	15.642	15.719	16.247	16.051	16.479	17.752	15.844	12.918	11.500
		Girls	13.620	13.519	17.657	18.147	18.335	20.279	19.917	17.463	15.730	14.806	15.978
Breath. Cap.	Decil.	Boys	23.239	17.182	18.416	17.907	18.181	17.922	16.775	21.613	19.338	16.852	15.348
		Girls	23.430	19.305	15.477	15.578	15.667	21.676	16.532	15.564	14.767	14.705	14.144
Sitting Height	Cms.	Boys	5.759	4.430	5.178	4.919	4.932	4.679	5.340	5.882	5.548	5.059	4.067
		Girls	4.564	6.799	4.361	4.770	4.757	5.422	5.452	5.157	4.412	3.867	3.865
Girth Chest	Cms.	Boys	7.625	5.780	6.207	6.010	7.065	6.571	7.508	7.518	7.518	5.341	5.583
		Girls	5.850	5.351	7.147	7.801	7.963	7.985	8.460	7.235	6.794	6.468	6.214
St. Right Arm	Kgms.	Boys	30.182	27.702	23.688	18.715	16.062	18.923	16.949	21.101	20.845	17.274	17.226
		Girls	30.276	20.392	22.598	18.949	17.500	17.719	13.866	14.930	14.149	14.865	12.430
St. Left Arm	Kgms.	Boys	28.985	23.947	23.543	20.374	17.587	18.258	20.008	19.572	21.636	17.268	16.859
		Girls	27.777	18.518	22.556	17.421	19.371	18.669	16.211	16.576	16.631	14.352	12.713
St. Upper Back	Kgms.	Boys	35.763	35.107	27.777	29.885	26.472	27.341	24.507	25.781	28.051	22.572	22.745
		Girls	38.523	30.872	30.000	23.297	22.906	22.916	22.235	21.681	20.124	22.232	18.148

7. Coefficients of Variability

When an absolute measure of variability as the standard deviation in inches or centimeters, pounds or kilograms, is divided by the average, a relative measure is obtained which is called the coefficient of variation, which is a pure number whereas the standard deviation involves various units of measurement. In making comparisons of the groups with respect to this variability, allowance can be made for the fact that the amount of central tendency influences the size of the S. D. that is obtained.

The discovery of the variability of a species or a class of organisms lies at the basis of the evolution of the species or class and is the determinant in tracing the factors of natural selection and inherent growth of the individuals.

A. GROUP I.

(1) *Data.* Pearson found that male infants at birth are more variable in height and weight than females, and he also found that from six to 10 years of age, females are more variable than males in both height and weight. For the 120 children from seven to 17 years of age, where repeated annual measurements have been made from six to 10 years on each child, the results here are contra-

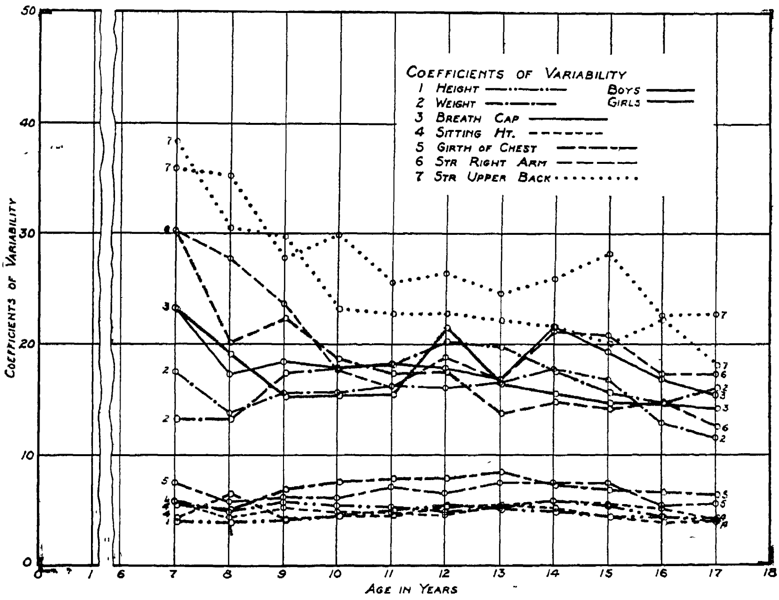


Chart LI

dictory to Pearson's for height and also for weight -at the years seven, eight, nine, 10, 11, 13, 14, 15, and 16 for height, and at seven, eight, 14, 15, for weight. For results see Table XXVI.

(2) *Conclusions*

I. For height boys have a greater variability than girls at all ages between seven and 17, except at 12 and 17; at 13 they are the same. Boys fluctuate more in variability in height than girls.

II. For weight boys have greater variability except at the ages of nine to 13, inclusive, and at 16 and 17. Girls also fluctuate more in variability in weight than boys.

III. For breathing capacity the boys are more variable than the girls at all ages except seven, eight and 12.

IV. The variability for sitting height is greater for boys at all ages except at eight, 12 and 13.

V. For chest girth, the variability is the same as for weight, the boys being more variable except from nine to 13, inclusive, and at 16 and 17.

VI. For strength of right arm, the variation for boys is greater for all ages except seven, 10 and 11, and the more variable ages for girls for the left arm are 11 and 12.

VII. The variability in strength of upper back for boys is greater than for girls, except at the ages of seven and nine.

TABLE XXVII

COEFFICIENTS OF VARIATION $= 100 \frac{\sigma}{m}$

FOR FOUR PHYSICAL TRAITS AT SIX YEARS OF AGE AND SIX YEARS LATER AND AT NINE OR 10 AND SIX YEARS LATER. BOYS AND GIRLS

Traits		Age 6	Age 12	At 9 or 10	6 yrs. later
Height	Boys	4.41	6.16	5.89	5.56
	Girls	3.92	4.30	4.39	3.82
Weight	Boys	13.81	19.05	17.58	16.17
	Girls	12.87	17.99	17.78	13.52
Breathing Capacity	Boys	20.31	18.39	17.55	21.77
	Girls	18.83	13.66	13.03	15.69
Strength of Right Arm	Boys	25.66	19.95	21.04	22.59
	Girls	20.50	16.37	16.42	13.80

VIII. These results show boys to be more variable in height and weight than Pearson (576) found and also Bowditch (113), who, in turn, found them more variable than did Boas and Wissler (100).

B. GROUP II.

(1) *Data.* In order to find the coefficient of variability for the same children for consecutive years, a group of 115 boys and girls whose measurements were taken at six years of age and consecutively for six years later, was used, and another group of 138 boys and girls of nine or 10 years of age, with consecutive measurements for six years. The results in Table XXVII show the following:

(2) *Conclusions*

I. Boys are more variable than girls at six years of age and six years later, also at nine or 10 and six years later.

II. For weight the girls are more variable at six years of age and six years later; at nine or 10, the variability is approximately the same, and six years later boys are more variable.

III. For breathing capacity boys are more variable at six years of age and six years later, and also at nine or 10 and six years later.

IV. For strength of right arm boys are more variable at six years of age and six years later, and also at nine or 10 and six years later.

V. Pearson also states that "both sexes lose not only variability, but correlations as they grow older." This statement is too general.

VI. Many of the coefficients of correlations increase with age, practically all increasing from nine or 10 to 14 years of age, the same holding true for the coefficients of variability for height, weight, and breathing capacity at 13 or 14 for boys and for girls. In the strength tests, the variations decrease in general with age, with a rise at 15 years of age.

VII. For the ages from nine or 10 and six years later, there is a decrease in the coefficient of variation for height and weight for boys and girls.

VIII. In breathing capacity there is an increase in variability for both boys and girls for these ages.

IX. In strength of right arm there is an increase in variability for boys and a decrease for girls for these ages.

C. GROUP III

(1) *Data.* For the group of 80 college girls whose measurements were followed throughout the four years of college, the results show:

TABLE XXVIII

COEFFICIENTS OF VARIATION = 100 $\frac{\sigma}{m}$
FOR FOUR PHYSICAL TRAITS FOR 80 SWARTHMORE COLLEGE GIRLS

Traits	Freshman	Sophomore	Junior	Senior
Height	3.67	3.55	3.44	3.52
Weight	16.43	15.89	16.01	17.13
Breathing Capacity	14.66	14.36	13.33	13.12
Strength of Right Arm	16.04	23.00	15.66	15.06

(2) *Conclusions*

I. The results for the eighty college girls from 17 to 21 years of age show a lower coefficient of variation than for girls from seven to 17 years of age, with a slight drop from the freshman year to the senior year.

II. The coefficient of variation for college girls for weight is lower than for the ages nine to 14 years, but higher than for 15, 16 and 17 years of age.

III. In breathing capacity there is a gradual decrease in the coefficient of variation for the college girls from the freshman to the senior year, and a lower coefficient than for any of the other ages previous to 17 years.

IV. For strength of right arm, the college girls show in general a coefficient of variability similar to the previous group after 13 years of age, the sophomore college girls being almost as high as the seven year old girls of the previous group.

8. GROWTH NORMS FOR GROUP USED FOR CORRELATIONS

a. *Data.* In order to compare the group of Horace Mann boys and girls whose correlations have been expressed in Tables XVI and XVII with larger groups and with those from other schools, the averages of the individual for the eight traits used in the 19 series of correlations from seven to 18 years of age are expressed in Table XXIX.

The yearly records include 10,560 yearly measurements based on

semi-annual examinations for eight years or more on the same individuals, or approximately 60,000 measurements.

Standard Weight-Height-Age and Height-Breathing Capacity-Age Tables for all of the normal standard children included in

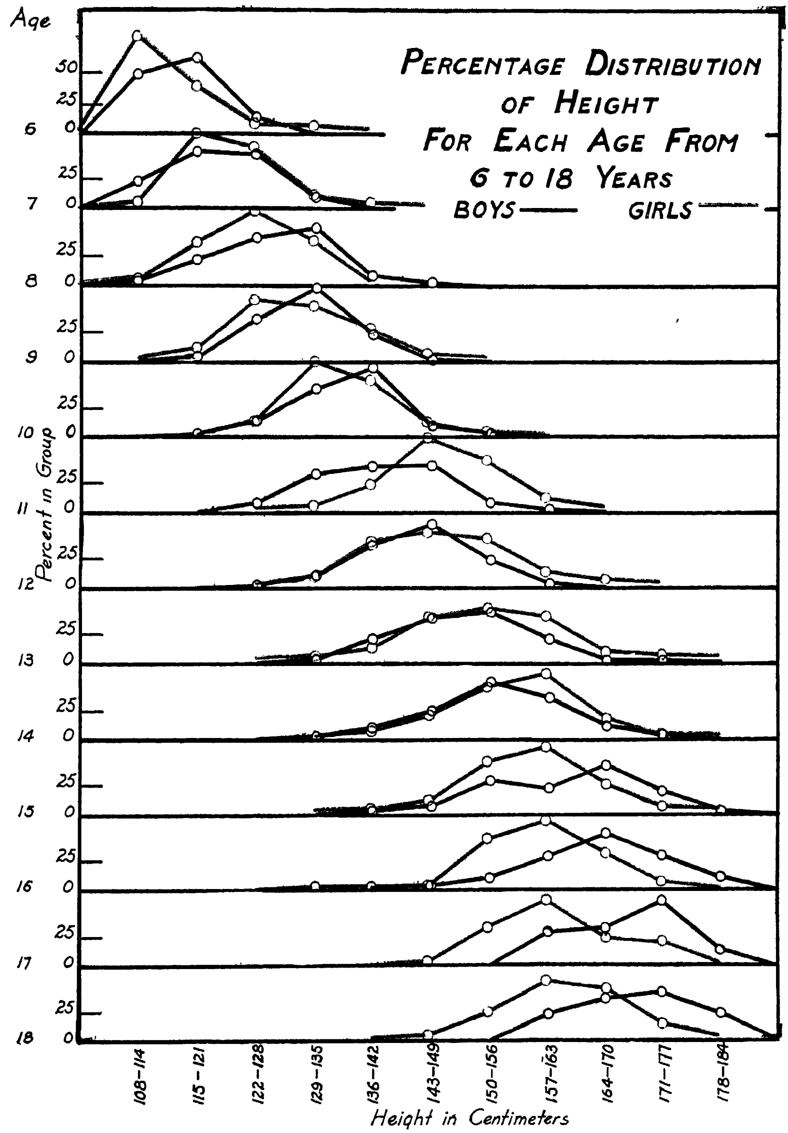
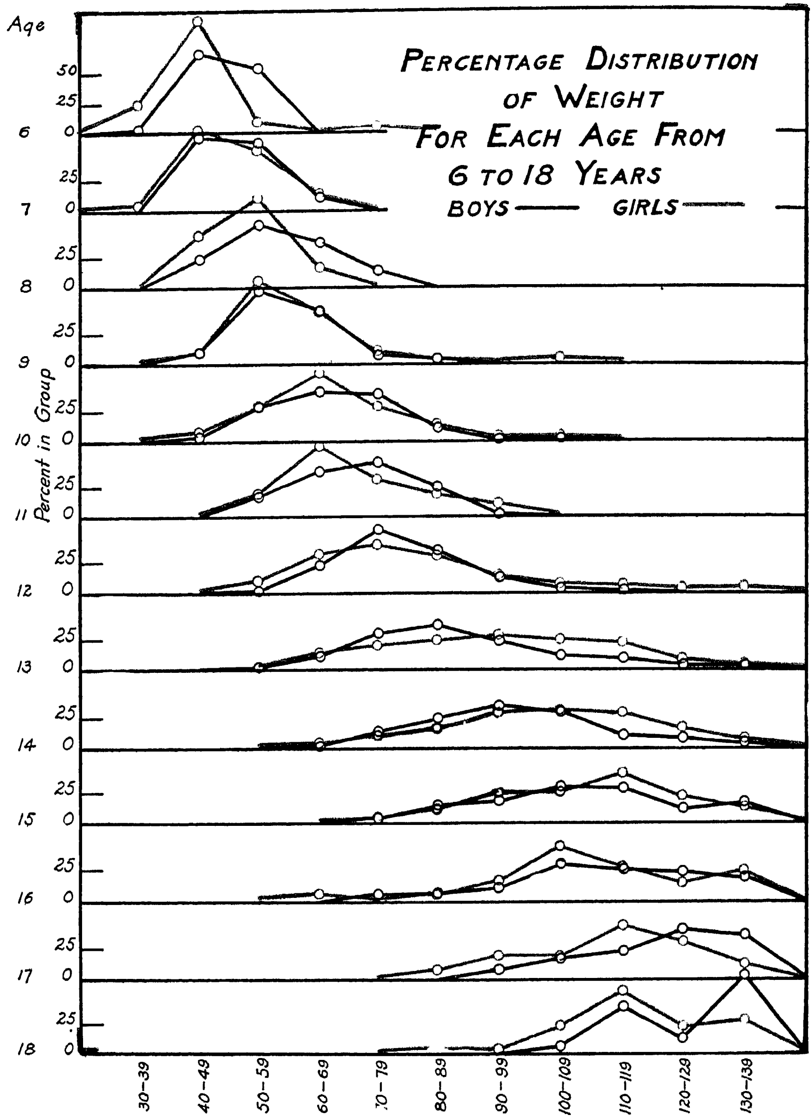


Chart LII

this *Study* have been worked out and will be published in the form of a separate Table and Practical Score Card.



Weight in Pounds

Chart LIII

b. *Conclusions*

These results are typical for height, weight and breathing capacity and almost identical when compared with the previous norms for larger groups in the 1914 Bulletin and the new ones on page 152. The means for the other five traits are also very similar to the norms in the Supplement. It will be noted that:

I. Girls are taller than the boys from 10 to 14 years of age.

II. Girls are heavier than boys from nine to 16 years of age.

III. Girls are inferior to boys in breathing capacity for all ages.

IV. Girls are superior to boys in sitting height from 10 to 16 years of age.

V. Girls are superior to boys in chest girth from 12 to 15 years of age.

VI. Girls are inferior to boys in strength of right and left arms and upper back at all ages.

VII. For normal children between seven and 17 years of age, these results may be considered as normal average standards.

c. *Applications.* As normal standards these averages, their deviations, the yearly increments, the indices and the annual percents of gain may be used for evaluating the growth of groups of American children within these age limits. The norms, which are among the highest in the world, show what school medical inspecton, physical training and directed play can do for children; for many of these boys and girls were sickly or under-nourished when small and several are Hebrews, who are racially of small stature and small features.

9. Mean Deviations in Growth of Correlation Groups

a. *Data.* In studying the comparative growth of a number of individuals for consecutive chronological ages, the mean deviations are important on account of showing the distribution of individuals within the groups. The mean deviations are shown in Table XXX.

b. *Conclusions*

I. The girls show higher mean variations than the boys at 12 and 13 years of age in height, lower at the other ages between seven and 18.

II. The mean variations for girls in weight and sitting height are higher for all ages from eight to 18 years.

TABLE XXIX

NORMS FOR GROUPS FOR EACH YEAR FOR EIGHT TRAITS WITH EIGHT YEARS OR MORE OF REPEATED MEASUREMENTS.

		7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
A Height	Boys	121.56	125.70	130.72	135.47	140.27	144.81	150.96	156.99	163.14	169.24	172.87
(in centimeters)	Girls	120.04	124.16	129.13	135.48	140.57	145.58	151.72	156.01	159.71	161.55	161.75
B Weight	Boys	22.87	24.68	27.49	29.90	32.62	35.51	40.05	44.50	49.86	54.96	59.13
(in kilograms)	Girls	22.76	24.41	27.75	31.41	34.36	37.97	43.68	48.10	53.40	55.38	55.70
C Breathing Capacity	Boys	12.92	14.55	16.29	17.87	19.80	21.76	24.44	27.76	32.06	36.79	40.51
(in deciliters)	Girls	11.95	12.95	14.86	16.69	18.51	20.76	23.59	25.70	28.44	29.92	30.40
D Sitting-Height	Boys	65.98	67.71	69.52	71.15	72.98	74.79	77.30	79.90	83.02	86.97	88.51
(in centimeters)	Girls	65.72	66.18	68.78	71.27	73.57	75.61	78.86	81.44	83.86	85.32	85.38
E Chest Girth	Boys	59.01	60.55	62.83	64.89	66.52	68.48	71.92	74.48	78.47	82.37	85.96
(in centimeters)	Girls	58.11	59.80	62.96	65.37	67.81	70.13	74.46	77.40	80.95	81.93	82.07
F Strength Right Arm	Boys	12.59	14.80	17.73	19.77	21.79	23.78	27.73	30.33	35.02	41.68	45.28
(in kilograms)	Girls	11.23	13.24	15.93	18.47	20.00	22.01	25.24	28.13	30.39	32.29	32.18
G Strength Left Arm	Boys	11.73	13.78	16.14	18.16	19.90	21.36	24.49	28.10	31.89	37.64	39.74
(in kilograms)	Girls	10.08	11.88	14.63	17.22	19.10	20.89	23.44	25.94	28.26	29.96	29.89
H Strength Upper Back	Boys	7.27	8.83	11.16	13.05	15.11	17.19	20.81	23.66	27.45	32.34	36.49
(in kilograms)	Girls	6.23	7.45	9.00	11.16	12.66	14.40	16.64	18.91	20.87	22.04	22.04

TABLE XXX

MEAN DEVIATIONS FOR GROUP IN TABLE XXIX

		7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
A Height (in centimeters)	Boys	6.00	5.17	6.09	6.02	6.08	5.79	6.34	7.03	6.95	6.59	5.72
	Girls	4.21	4.02	4.37	5.02	5.75	6.13	6.36	6.25	5.84	5.87	5.67
B Weight (in kilograms)	Boys	2.80	2.64	3.38	3.83	4.47	4.44	5.25	6.39	6.40	5.90	5.38
	Girls	2.43	2.65	3.85	4.55	5.10	6.07	6.82	6.58	6.44	6.24	6.65
C Breathing Capacity (in deciliters)	Boys	2.35	2.02	2.31	2.44	2.86	3.14	3.27	4.49	4.67	4.96	4.85
	Girls	2.26	2.03	1.89	2.11	2.26	2.93	3.09	3.29	3.40	3.68	3.53
D Sitting-Height (in centimeters)	Boys	3.38	2.49	2.88	2.84	2.88	2.70	3.15	3.59	3.75	3.42	2.75
	Girls	2.51	3.00	2.47	2.74	2.86	3.29	3.46	3.50	2.99	2.76	2.75
E Chest Girth (in centimeters)	Boys	3.19	2.67	3.32	3.25	3.68	3.65	4.42	4.52	4.94	3.61	3.79
	Girls	2.66	2.41	3.63	4.17	4.30	4.46	4.82	4.23	4.24	3.99	3.74
F Strength Right Arm (in kilograms)	Boys	3.09	3.40	3.49	3.11	2.80	3.52	3.57	5.01	5.89	5.45	6.23
	Girls	2.92	2.18	2.76	2.82	2.87	3.04	2.96	3.36	3.34	3.60	3.33
G Strength Left Arm (in kilograms)	Boys	2.64	2.63	3.02	2.82	2.80	3.22	3.83	4.33	5.50	5.09	5.23
	Girls	2.23	1.94	2.61	2.45	3.03	3.14	3.19	3.06	3.74	3.38	2.82
H Strength Upper Back (in kilograms)	Boys	2.09	2.58	2.61	3.00	2.96	3.88	4.16	5.00	6.00	6.20	6.72
	Girls	1.85	1.91	2.15	2.20	2.31	2.57	3.10	3.43	3.41	3.78	3.11

III. Girls also have a higher mean variation in chest girth from nine to 17 years of age.

IV. Girls have a lower mean variation for all ages in breathing capacity.

V. Girls have lower mean variations in strength of right arm, left arm and upper back for all ages from seven to 18 years.

VI. In every trait except in weight and chest girth the boys show a wider range of distribution for these ages.

VII. The greatest mean variations for both boys and girls are during the characteristic adolescent ages for each; the smallest are during the earlier periods from seven years to nine years of age.

10. Yearly Increments of Growth of Group in Table XXIX

a. *Data.* The actual annual increments of yearly growth are significant for this group as shown in Table XXXI. "A study of the individual measurements in height reveals different correlations in growth for boys and girls above the median from those below. That is, the rhythms of fluctuations of growth for tall children differ materially from those for short children. This is demonstrated by the norms found, which serve in this connection as a temporary expedient for estimating the relative heights of the children and as a means for dividing them into two general groups, those lying on and above the median and those lying below the median. There are some who cross the median, and others whose curves fluctuate toward or from the median. Those lying above the median height begin and end their periods of acceleration and arrest earlier than those below the median." For increment data see former monograph (27), pages 30 and 31. For new norms for tall and short girls see table XXXVI pages 165 and 166.

"As will be noted, the results give the greatest absolute increment and the greatest average deviations during the adolescent period, beginning at 12 years of age for boys above the median height and beginning at 10½ years for the girls above the median. This marked acceleration continues until 15½ for boys and until 13 for girls. For those below the median height the greatest average acceleration begins at 14 years for boys, and at 11½ years for girls, and continues, for the boys, until 17½ and for the girls until 15½.

TABLE XXXI

INCREMENTS OF GROUP IN TABLE XXIX FOR ONE YEAR PERIODS FROM SEVEN TO 17 YEARS OF AGE

		7-8 yrs.	8-9 yrs.	9-10 yrs.	10-11 yrs.	11-12 yrs.	12-13 yrs.	13-14 yrs.	14-15 yrs.	15-16 yrs.	16-17 yrs.
A Height	Boys	4.14	5.02	4.75	4.80	4.54	6.15	6.03	6.15	6.10	3.63
(in centimeters)	Girls	4.12	4.97	6.35	5.09	5.01	6.14	4.29	3.70	1.84	.20
B Weight	Boys	1.81	2.81	2.41	2.72	2.89	4.54	4.45	5.36	5.10	4.17
(in kilograms)	Girls	1.65	3.34	3.66	2.95	3.61	5.71	4.42	5.30	1.98	.32
C Breathing Capacity	Boys	1.63	1.74	1.58	1.93	1.96	2.68	3.32	4.30	4.73	3.72
(in deciliters)	Girls	1.00	1.91	1.83	1.82	2.25	2.83	2.11	2.74	1.48	.48
D Sitting Height	Boys	1.73	1.81	1.63	1.83	1.81	2.51	2.60	3.12	3.95	1.54
(in centimeters)	Girls	1.46	2.60	2.49	2.30	2.04	3.25	2.58	2.42	1.46	.06
E Chest Girth	Boys	1.54	2.28	2.06	1.63	1.96	3.44	2.56	3.99	3.90	3.59
(in centimeters)	Girls	1.69	3.16	2.41	2.44	2.32	4.33	2.94	3.55	.98	.14
F Strength Right Arm	Boys	2.21	2.93	2.04	2.02	1.99	3.95	2.60	4.69	6.66	3.60
(in kilograms)	Girls	2.01	2.69	2.54	1.53	2.01	3.23	2.89	2.26	1.90	—.11
G Strength Left Arm	Boys	2.05	2.36	2.02	1.74	1.46	3.13	3.61	3.79	5.75	2.10
(in kilograms)	Girls	1.80	2.75	2.59	1.88	1.79	2.55	2.50	2.32	1.70	—.07
H Strength Upper Back	Boys	1.56	2.33	1.89	2.06	2.08	3.62	2.85	3.79	4.89	4.15
(in kilograms)	Girls	1.22	1.55	2.16	1.50	1.74	2.24	2.27	1.96	1.17	.00

"The rhythms and fluctuations of growth in height for the children above the median show that these boys and girls mature in physiological growth earlier than those below the median, since their periods of acceleration and arrest begin earlier and end earlier. There are individual measurements lying on either side of these medians, arranged in all probability in a normal distribution from the tallest to the shortest for each chronological age. If this is the case, as the individual curves will show, we are justified in making averages or medians only when the average or norm is based on the physiological age instead of the chronological age. A new and very important educational problem is evoked here: How may we formulate a measuring scale for determining the physiological age of the child? A careful study of individual growth curves, based on consecutive measurements, it is hoped, will help to answer this question" (27).

b. *Conclusions*

I. In yearly increments of growth there are not only sex differences, but a wide range of differences for each trait at various ages.

II. The increments are higher in the case of girls than of boys as follows: from nine to 13 years of age for weight; from 11 to 13 years of age for breathing capacity; from eight to 13 years of age for sitting height; from eight to 13 years of age for chest girth; from eight to 13 years of age for strength of left arm. They are inferior at all other ages for all traits and for these ages (eight to 13) for strength of right arm and upper back.

11. Yearly Percent of Gain From Seven to 14 Years of Age

This table is significant in that it shows the annual increase in increment in growth for the eight physical traits under consideration. The yearly gains in percent can be best gleaned from Table XXXII. It should be noted that

I. For growth in height the yearly increment of percent is very uniform for boys from seven to 16, with a short rise from 12 to 13 years of age; for girls from seven to 13 the yearly increment of percent is very uniform, with the rise from 12 to 13 and a cessation after this age.

II. For growth in weight there is a higher percentage increment

TABLE XXXII

YEARLY PERCENT OF GAIN FROM SEVEN TO 17 YEARS OF AGE

Ages		7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	Average
A. Height	Boys	3.4	3.9	3.6	3.5	3.2	4.2	3.3	3.9	3.7	2.1	3.48
(in centimeters)	Girls	3.4	4.0	4.9	3.7	3.5	4.2	2.8	2.3	1.1	.1	3.00
B. Weight	Boys	7.9	11.3	8.7	9.0	8.8	12.7	11.1	12.0	10.2	7.5	9.92
(in kilograms)	Girls	7.2	13.6	13.1	9.3	10.5	15.0	10.1	11.0	3.7	.5	9.40
C. Breathing Capacity	Boys	12.6	11.9	9.6	10.8	9.8	12.3	13.5	15.4	14.7	10.1	12.07
(in deciliters)	Girls	8.3	14.7	12.3	10.9	12.1	13.6	8.9	10.6	5.2	1.6	9.82
D. Sitting Height	Boys	2.6	2.6	2.3	2.5	2.4	3.3	3.3	3.9	4.7	1.7	2.93
(in centimeters)	Girls	2.7	3.9	3.4	3.2	2.7	4.2	3.2	2.9	1.7	.07	2.60
E. Chest Girth	Boys	2.6	3.7	3.2	2.5	2.9	5.0	3.5	5.3	4.9	4.3	3.79
(in centimeters)	Girls	2.9	5.2	3.8	3.7	3.4	6.1	3.9	4.5	1.2	.1	3.48
F. Strength Right Arm	Boys	17.5	19.7	11.5	10.2	9.1	16.6	9.3	15.4	19.0	8.6	13.69
(in kilograms)	Girls	17.8	20.3	15.9	8.2	10.0	14.6	11.4	8.0	6.2	—.3	11.21
G. Strength Left Arm	Boys	17.4	17.1	12.5	9.5	7.3	14.6	14.7	13.4	18.0	5.5	13.00
(in kilograms)	Girls	17.8	23.1	17.7	10.9	9.3	12.2	10.6	8.9	6.0	—.2	11.63
H. Strength of Upper Back	Boys	21.4	26.3	16.9	15.7	13.7	21.0	13.6	16.0	17.8	12.8	17.52
(in kilograms)	Girls	19.5	20.8	24.0	13.4	13.7	15.5	13.6	10.3	5.6	0	13.64

for all ages up to 13 years for boys, with more irregularity than for the previous traits outlined, and with the peak of increase between 12 and 13.

III. For breathing capacity the percentage increase is a little higher and more irregular than for height. The girls are higher than the boys until 13 years with no definite peak period.

IV. The lowest annual increase in percent is in sitting height for boys and girls, and the highest in strength of upper back. This is also shown graphically in the profile charts, pages 111, 112, 113 and 114. For sitting height the annual percent of gain is lower for the boys than for girls until 12 years of age.

V. Growth in chest girth, which is also lower for boys until 14 years of age, is also small and more variable than for sitting height.

VI. and VII. For strength of the arms the annual increase is a little higher than for the previous traits, with variations for the two arms and for boys and girls, the boys increasing more on the average than the girls.

VIII. For upper back there is a greater annual increase than for other traits, but there is so much variation that no definite age stands out prominently, the boys growing more on the average than the girls.

12. Indices of Growth of Group in Table XXIX

a. *Data.* As previously emphasized, the relationship between the growth of two physical traits which may be expressed as an index, is more significant than is the growth of either. The importance of the index or coefficient of robustness (the weight-height coefficient) is outlined in Part IV and this index should form the normal standard of growth in place of either height or weight. Table XXXIII gives the average indices of all ages and for each sex. There is little or no apparent difference, as a rule, between the tall boys and the short boys, except that the tall individuals have high indices early. This clearly substantiates the important conclusions previously stated that the development of any normal physiological change in the traits measured occurs earlier for tall children. For data see Figs. 1 to 29 and pages 30 to 71 in the earlier monograph (27).

TABLE XXXIII

AVERAGE INDICES OF GROWTH OF GROUP IN TABLE XXIX

		7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
Weight-Height Index	Boys	.188	.196	.210	.221	.233	.245	.265	.283	.306	.325	.342
		(1.05)*	(1.10)	(1.17)	(1.24)	(1.30)	(1.37)	(1.48)	(1.58)	(1.71)	(1.82)	(1.81)
	Girls	.190	.197	.215	.232	.244	.261	.288	.308	.334	.343	.344
		(1.06)	(1.10)	(1.20)	(1.30)	(1.36)	(1.46)	(1.61)	(1.72)	(1.87)	(1.92)	(1.92)
Vital-Height Index	Boys	.106	.116	.125	.132	.141	.150	.162	.177	.197	.217	.234
	Girls	.100	.104	.115	.123	.132	.143	.155	.165	.178	.185	.188
Sitting Height-Height Index	Boys	.543	.539	.532	.525	.520	.516	.512	.509	.509	.514	.512
	Girls	.547	.533	.533	.526	.523	.519	.520	.522	.525	.528	.528
Chest Girth-Height Index	Boys	.485	.482	.481	.479	.474	.473	.476	.474	.481	.487	.497
	Girls	.484	.482	.488	.483	.482	.482	.491	.496	.507	.507	.507
Strength Right Arm-Height Index	Boys	.104	.118	.136	.146	.155	.164	.184	.193	.215	.246	.262
	Girls	.094	.107	.123	.136	.142	.151	.166	.180	.190	.200	.199
Strength Left Arm-Height Index	Boys	.097	.110	.123	.134	.142	.148	.162	.179	.195	.222	.230
	Girls	.084	.096	.113	.127	.136	.143	.154	.166	.177	.185	.185
Strength Upper Back-Height Index	Boys	.060	.070	.085	.096	.108	.119	.138	.151	.168	.191	.211
	Girls	.052	.060	.070	.082	.090	.099	.110	.121	.131	.136	.136

*English measure

That the weight-height indices vary with different nationalities can be demonstrated by selecting weight and height tables from Part V. Take for example Erismann, Baldwin, Pagliani, Bobbitt and Misawa. From eight to 15 years of age the indices for the Russians increase for the boys from .201 to .361; for the Americans from .196 to .306; for the Italians from .175 to .275; for the Filipinos from .174 to .268; and for the Japanese from .168 to .265. That is, the Russians and Americans are heavier for their stature than are the other nationalities represented.

b. *Conclusions*

(1) WEIGHT-HEIGHT INDEX

I. The weight-height index is the most practical criterion of normal growth in robustness and, other conditions being normal, in general nutrition.

II. The weight-height indices increase from six to 18 years of age on the average 100 percent, which shows that weight increases more proportionately than height.

III. A well-developed tall or short child approaches within 15 per cent of the weight-height index for the chronological age to which the child's height corresponds.

IV. For tall boys and tall girls the coefficient for the weight-height is in advance chronologically of that for the mean or average and the reverse holds true for short children. The tall heavy children are older physically.

V. In interpreting and evaluating the seven series of indices for each age for each sex, it should be noted that the weight-height indices for girls are higher at all ages, which means the girls are proportionally heavier for their height than boys.

(2) VITAL-HEIGHT INDEX

I. The vital-height index is a good criterion of the respiratory height relationship.

II. The vital-height index more than doubles for boys during the ages from six to 18 years and nearly doubles for girls, which shows that in growth in breathing capacity boys increase proportionately more than in growth in height.

III. The vital-height index is higher for the boys than for the girls at all ages, which shows that boys have greater breathing capacity for their heights than girls.

IV. A well developed tall or short child should approach within 15 per cent of the vital-height index for the chronological age to which the child's height corresponds.

V. For tall boys and tall girls the coefficient for the vital-height is in advance chronologically of that for the mean or average and the reverse holds true for short children.

(3) SITTING HEIGHT-HEIGHT INDEX

I. The sitting height indices for boys and girls show on the average a slight decrease from six to 16 years of age, and for boys from six to 13 years of age, which shows that standing height is increasing more proportionately at these ages than height-sitting.

II. Girls maintain a relatively higher sitting height-height relationship than boys.

(4) CHEST GIRTH-HEIGHT INDEX

I. Chest girth-height indices change little from seven to 13 years of age, with a slight drop for ages from 11 to 15.

II. Girls have a slightly higher index than boys. After 13 the index is considerably higher for girls.

(5) STRENGTH OF RIGHT ARM-HEIGHT INDEX

I. The strength of right arm-height indices increase on the average steadily from six to 18 years to more than 100 percent for boys and approximately 100 percent for girls, which shows that the strength of the right arm increases more proportionately than the stature.

II. In the strength-height relationships for right arm the boys are invariably superior.

(6) STRENGTH OF LEFT ARM-HEIGHT INDEX

I. The strength of left arm-height indices increase on the average steadily from six to 18 years to more than 100 percent for boys and approximately 100 percent for girls, which shows that the strength of the left arm increases more proportionately than the stature.

II. The indices for the left arm are uniformly lower with this group of children than those for the right.

III. In the strength-height relationships for left arm the boys are invariably superior.

(7) STRENGTH OF UPPER BACK-HEIGHT INDEX

I. The indices for growth of strength in upper back increase more from six to 18 than any of the other indices. For the boys

this increase is nearly 300 percent, for the girls about 250 percent.

II. Boys increase most during the ages from 14 to 18 and girls increase least after 15 years of age.

III. In the strength-height relationships for upper back the boys are invariably superior.

13. Percent of Increase Between Seven, 12, and 17 Years of Age

a. *Data.* What percent of a boy's or girl's growth at 17 years of age has he or she reached at seven years of age, and at 12 years of age? Do boys and girls grow more between seven and 12 years of age or between 12 and 17 years of age? These are very important questions from many standpoints for individuals and the problems are analyzed further by a study of individual growth curves. The averages as given in Table XXXIV and XXXV will answer the question in a general way and will show the group tendencies.

Table XXXIV

PERCENT OF INCREASE BETWEEN SEVEN, 12 AND 17 YEARS OF AGE

Traits		At 12 yrs.	At 17 yrs.	Between 7 and 12 yrs.	Between 12 and 17 yrs.
Height	Boys	119%	142%	19%	23%
	Girls	121	135	21	14
Weight	Boys	155	259	55	104
	Girls	167	245	67	78
Breathing Capacity	Boys	168	314	68	146
	Girls	174	254	74	80
Sitting Height	Boys	113	134	13	21
	Girls	115	130	15	15
Girth of Chest	Boys	116	146	16	30
	Girls	121	141	21	20
Strength of Right Arm	Boys	189	360	89	171
	Girls	196	287	96	91
Strength of Left Arm	Boys	182	339	82	157
	Girls	207	297	107	90
Strength of Upper Back	Boys	236	502	136	266
	Girls	231	354	131	123

TABLE XXXV

PERCENT OF FINAL GROWTH AT 17 YEARS OF AGE THAT HAS BEEN ATTAINED AT SEVEN AND 12 YEARS OF AGE

Traits		At 7 yrs.	At 12 yrs.	Between 7 and 12 yrs.	Between 12 and 17 yrs.
Height	Boys	70.3%	83.8%	13.5%	16.2%
	Girls	74.2	90.0	15.8	10.0
Weight	Boys	38.7	60.1	21.4	39.9
	Girls	40.9	68.2	27.3	31.8
Breathing Capacity	Boys	31.9	53.7	21.8	46.3
	Girls	39.3	68.3	29.0	31.7
Sitting Height	Boys	74.5	84.5	10.0	15.5
	Girls	77.0	88.6	11.6	11.4
Girth of Chest	Boys	68.6	79.7	11.1	20.3
	Girls	70.8	85.5	14.7	14.5
Strength of Right Arm	Boys	27.8	52.5	27.4	47.5
	Girls	34.9	68.4	33.5	31.6
Strength of Left Arm	Boys	29.5	53.7	24.2	46.3
	Girls	33.7	69.9	36.2	30.1
Strength of Upper Back	Boys	19.9	47.1	27.2	52.9
	Girls	28.3	65.3	37.0	34.7

		7 yrs.	12 yrs.	17 yrs.
Sitting Height to Standing Height	Boys	54.3%	51.6%	51.2%
	Girls	54.7	51.9	52.8

b. *Conclusions*

I. Girls have completed at seven years of age on the average in each of the eight physical traits: height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm, and strength of upper back, a higher percent of their final development (at 17) than have boys.

II. Girls gain between seven and 12 years of age a greater percent of their final growth (at 17) than do boys, in all of the eight traits: height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm, and strength of upper back.

III. From 12 to 17 years of age, girls gain a higher percent than boys in sitting height, chest girth, strength of right arm, left arm and upper back.

IV. Boys and girls both gain a higher percent from 12 to 17 years of age in the other traits of weight and breathing capacity.

V. The girls at seven years of age have reached a stage of development considerably in advance of that of boys, and girls continue this lead in all phases of growth, so that a 12 year old girl is as far advanced toward her final growth at 17 as a 14 year old boy.

VI. The direct percent of sitting height to standing height at seven, 12 and 17 is almost identical for boys and girls. The ratio is approximately 1-2 being slightly below this at seven years of age.

VII. Girls grow more proportionally than boys from seven to 12 years of age in height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm. Boys gain slightly more in strength of upper back.

VIII. Boys grow more proportionally than girls from 12 to 17 years of age in height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm and strength of upper back.

14. Norms for Tall and Short Girls

These norms for girls above or below median height show that on an average the tall girls surpass the short girls in all of the eight physical traits outlined. They also show that tall girls grow differently than short girls. These norms supplement those on page 152, but include more cases.

TABLE XXXVI

NORMS FOR TALL AND SHORT GIRLS, WITH STANDARD DEVIATIONS

GIRLS	AGE	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11
Average														
A. Height	Tall	111.3	113.0	116.4	119.5	122.3	125.6	128.4	131.3	133.3	137.2	138.6	142.2	145.1
	Dev.	1.37	1.83	3.0	2.6	1.97	2.23	1.96	2.51	2.18	2.64	2.69	2.82	3.3
	Short	102.4	107.1	109.0	113.0	114.4	117.9	119.7	122.3	125.2	126.9	130.0	132.8	135.1
	Dev.	1.38	1.51	2.1	2.2	3.43	2.37	2.08	2.71	2.84	2.17	3.06	3.29	3.7
B. Weight	Tall	18.8	19.9	20.8	22.2	23.0	25.0	26.1	28.2	28.5	31.6	32.4	35.0	35.5
	Dev.	1.87	1.47	1.1	1.5	1.64	2.59	2.72	3.08	2.83	3.24	4.08	4.56	5.4
	Short	15.8	16.2	18.2	18.8	19.5	20.9	21.8	22.7	24.2	25.3	27.4	29.1	30.3
	Dev.	1.27	2.68	1.5	1.6	1.82	1.82	2.04	1.62	2.56	2.11	3.28	3.74	5.4
C. Breathing Capacity	Tall	8.6	9.4	10.7	11.2	12.1	13.5	13.5	15.3	15.8	17.1	17.1	18.8	19.2
	Dev.	1.47	1.07	.82	.72	11.2	1.30	1.20	1.43	1.27	1.62	1.24	1.67	1.84
	Short	5.1	7.7	9.7	10.1	9.9	11.3	11.8	13.0	13.1	14.3	15.0	16.1	16.7
	Dev.	.98	1.20	1.4	.67	6.77	1.39	1.27	1.02	1.16	1.20	1.47	1.70	1.65
D. Sitting Height	Tall	60.6	62.3	63.3	64.8	65.5	67.4	68.4	69.6	70.2	71.9	72.2	73.8	75.0
	Dev.	1.51	1.9	1.7	1.7	2.09	1.52	1.36	1.54	1.7	1.78	1.62	1.63	1.9
	Short	56.2	59.6	59.8	62.1	61.8	63.9	64.4	66.0	66.5	67.9	68.7	70.1	71.1
	Dev.	.28	2.2	7.8	2.5	2.21	1.41	1.87	1.38	1.6	1.56	1.96	2.35	2.3
E. Girth of Chest.	Tall	55.5	57.1	57.3	59.2	59.1	61.2	61.6	64.1	63.3	66.3	67.4	68.5	69.1
	Dev.	9.0	1.5	1.2	2.5	1.97	3.02	1.88	3.15	2.86	3.62	4.42	3.81	4.8
	Short	52.9	53.5	54.3	55.9	55.4	57.2	57.6	58.6	60.4	61.0	63.2	64.4	65.6
	Dev.	2.47	1.46	2.5	2.3	2.4	2.0	2.7	2.09	2.64	2.16	3.14	3.51	3.7
F. Strength of Right Arm	Tall	7.6	9.7	10.4	11.3	11.9	13.8	14.7	16.6	16.9	18.4	19.1	20.5	21.2
	Dev.	1.8	2.6	1.8	2.0	1.97	2.19	2.17	2.1	2.82	2.87	2.63	6.17	3.2
	Short	6.3	7.7	9.1	10.2	10.1	12.3	12.3	13.7	14.5	15.3	17.3	18.2	18.9
	Dev.	1.75	1.6	2.0	4.5	2.08	1.6	2.03	1.6	2.12	1.64	2.2	2.49	2.4
G. Strength of Left Arm	Tall	7.4	10.2	10.8	11.7	11.9	13.7	14.7	16.5	16.7	18.4	19.1	20.4	20.8
	Dev.	1.62	2.2	1.2	2.2	1.95	1.98	2.39	2.04	2.88	2.86	2.67	2.79	2.7
	Short	6.4	7.2	8.5	10.3	10.0	12.2	12.2	13.8	14.5	15.1	17.3	17.9	18.9
	Dev.	1.8	1.83	1.11	1.18	2.0	1.66	1.76	1.68	2.11	1.74	2.46	2.32	2.3
H. Strength of Upper Back	Tall	2.4	4.2	4.7	5.0	6.2	6.9	7.7	9.1	10.1	11.1	11.0	11.9	12.7
	Dev.	1.24	1.03	1.1	1.73	1.71	2.24	1.87	2.04	1.29	2.52	2.65	2.47	2.9
	Short	3.5	2.8	3.5	3.9	3.9	5.6	5.8	7.5	7.4	8.9	9.3	10.5	10.9
	Dev.	1.5	.64	1.	1.17	1.07	1.84	1.51	1.26	3.19	1.55	1.67	1.88	2.3

TABLE XXXVI, Continued

GIRLS	AGE	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½
Average														
A. Height	Tall	148.7	151.4	155.2	157.5	160.1	162.3	163.7	163.9	165.6	166.9	166.6	166.8	167.3
	Dev.	3.0	3.8	3.5	3.5	3.0	2.9	3.4	2.9	3.4	3.1	3.4	3.0	3.8
	Short	138.4	140.0	144.7	147.7	149.4	152.0	152.9	154.1	154.4	155.1	155.4	156.2	155.3
	Dev.	3.7	3.9	4.0	3.4	3.7	3.1	2.8	2.9	2.8	2.5	2.95	2.1	4.6
B. Weight	Tall	39.8	40.3	45.5	46.4	50.8	52.1	54.2	54.1	57.2	57.0	59.4	58.5	58.8
	Dev.	5.1	5.9	5.9	6.3	6.2	6.1	5.4	6.5	7.0	4.8	6.3	4.3	5.3
	Short	32.4	34.7	38.5	40.7	43.8	44.7	48.3	47.8	50.5	49.1	51.4	50.6	53.2
	Dev.	4.0	5.1	5.6	5.3	5.8	5.7	4.8	4.3	4.9	4.3	3.6	4.2	3.2
C. Breathing Capacity	Tall	21.4	21.6	24.7	24.8	27.2	27.3	30.1	29.0	31.1	32.1	32.1	33.8	32.1
	Dev.	2.03	2.45	2.32	2.44	2.85	2.55	2.96	3.78	3.12	3.61	4.65	2.63	4.27
	Short	18.2	18 4	21.0	21.7	23.1	24.0	25.0	25.6	26.1	25.6	26.8	27.3	26.4
	Dev.	1.93	1.98	2.14	2.09	2.68	2.86	1.85	2.67	1.90	2.46	2.13	2.46	1.32
D. Sitting Height	Tall	76.7	78.1	79.8	81.0	82.1	83.9	84.9	84.8	86.7	87.3	88.1	87.6	88.1
	Dev.	1.9	2.6	2.6	3.9	2.5	1.8	2.15	1.6	1.2	2.2	2.7	1.8	2.8
	Short	72.9	74.0	76.3	77.7	78.7	80.5	81.0	81.7	82.3	82.7	83.4	83.3	83.5
	Dev.	2.9	2.6	3.1	2.7	2.5	2.3	2.2	1.7	1.7	1.3	1.4	1.0	4.0
E. Girth of Chest	Tall	72.1	72.3	76.0	76.6	80.0	80.1	81.7	81.0	82.4	82.5	83.4	83.6	83.4
	Dev.	3.7	4.9	4.5	4.6	4.5	4.4	3.4	4.1	3.9	3.0	4.0	2.9	3.8
	Short	67.3	68.8	71.7	73.5	75.7	76.4	78.7	78.2	80.3	78.3	80.1	79.2	82.2
	Dev.	3.3	4.3	4.2	3.8	4.0	4.0	4.2	2.7	3.0	3.1	2.7	2.4	1.85
F. Strength of Right Arm	Tall	23.2	24.0	26.0	26.3	28.0	29.0	30.1	32.2	31.4	32.9	34.0	32.0	34.3
	Dev.	2.4	3.4	3.1	3.0	3.3	3.45	3.0	4.6	4.3	3.6	3.3	2.8	4.2
	Short	20.6	21.8	23.3	24.7	26.6	27.3	28.8	28.9	29.1	29.6	29.8	29.7	29.2
	Dev.	2.3	3.4	2.6	3.8	2.4	3.6	2.6	3.0	2.9	3.6	3.4	3.8	1.9
G. Strength of Left Arm	Tall	22.3	23.2	24.9	25.8	27.1	27.8	28.5	29.3	29.3	30.4	30.3	30.0	29.9
	Dev.	2.5	3.0	2.9	3.1	2.9	3.3	3.1	3.3	4.0	3.6	2.9	3.8	4.0
	Short	20.3	21.6	22.2	24.1	25.5	26.1	27.2	28.0	28.0	27.9	28.4	27.7	26.3
	Dev.	2.5	3.2	2.6	2.9	1.7	3.5	2.2	3.4	2.5	3.7	3.3	3.2	1.8
H. Strength of Upper Back	Tall	13.7	13.7	16.2	16.7	17.5	17.2	19.2	19.7	22.4	22.7	22.8	22.9	23.0
	Dev.	2.5	3.1	3.0	3.5	2.35	2.6	2.3	3.5	3.0	3.8	4.2	2.8	2.4
	Short	12.3	12.8	14.0	15.5	17.0	16.5	18.1	17.1	19.2	18.6	20.7	19.0	21.0
	Dev.	2.5	2.9	2.2										3.3

PART III

CHAPTER VII

ANATOMICAL AGE

1. The Anatomical Development of Boys and Girls

Two closely related ages which characterize a child's development quite as much as its chronological age in years, months and days, but are less understood, less commonly used, and therefore less familiar to parents and teachers, are the anatomical and physiological age. These denote the physical, or anatomical, growth and the accompanying stages of physical maturation of the individual as indicated by growth of bones, eruption of teeth, color of eyes, metabolism, marked functional changes in sex organs, changes of voice and many other phases of physiological development not so apparent to the casual observer.

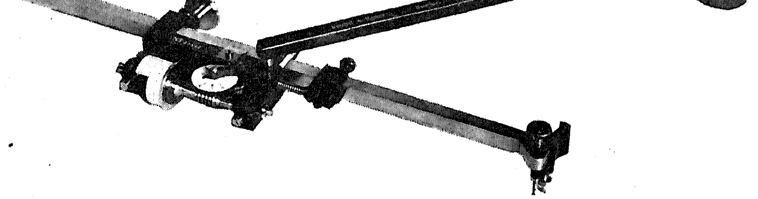
Children of the same chronological age may vary greatly in their anatomical and physiological development. Since physical growth in the larger sense conditions all other aspects of development, it is essential that these ages be discussed in detail. Few scientists have attempted to differentiate between these two ages, but this is essential if a careful study is to be made of the development of childhood. An analysis of the anatomical growth of the carpal bones (the wrist) will be made, a diagnosis of the physiological age at adolescence will be outlined empirically, and some specific correlations between the two ages with applications will follow.

a. *Roentgenograms as Criteria of Anatomical Age.* In order to throw more light on the previous data on physical growth, the writer made a comparative study of the carpal bones of a group of boys between the ages of 11 and 13 and a group of girls between the ages of 10 and 13, the growth being followed for three years. These children from the seventh school grade of the University of Iowa Junior High School, are as nearly as could be determined in a preliminary way, normal children from good, representative homes, with normal school progress, as indicated by school grades, school

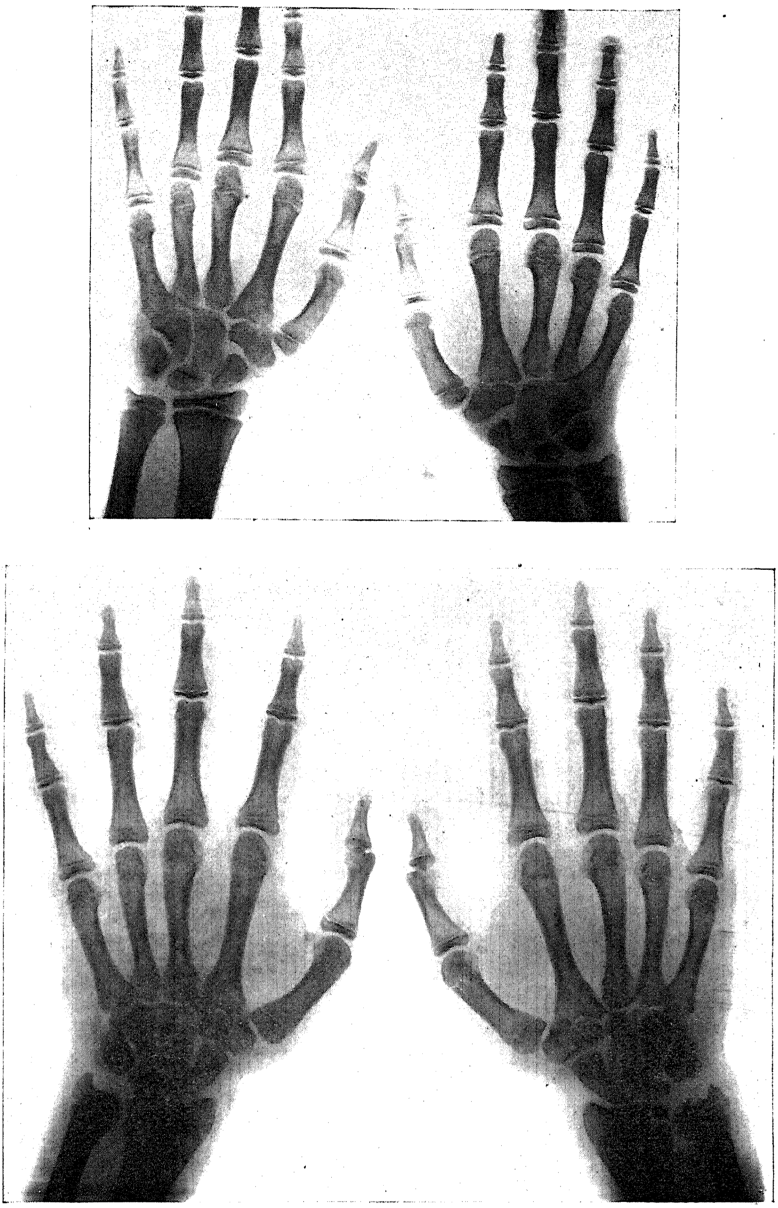
marks, and a series of mental examinations for the three consecutive years. The analyses give a good insight into the physical status of these young adolescents, since the ossification of the bones of the wrist is representative of the skeletal development in general.

The roentgenographs included in this investigation were taken in the Department of Roentgenology of the University College of Medicine by Dr. Bundy Allen. One series was taken in 1918 just before the writer was called into the U. S. Army, and another series on the same individuals after his return, and a third series in October, 1920. The roentgenograms were of the exact natural size and the two hands were placed in a uniform position as far as possible. The individual differences in the forms and positions of the carpal bones and the difficulty of differentiating between various stages as the cartilaginous tissue develops into osseous substance present distinct problems in determining the topographical area of the bones.

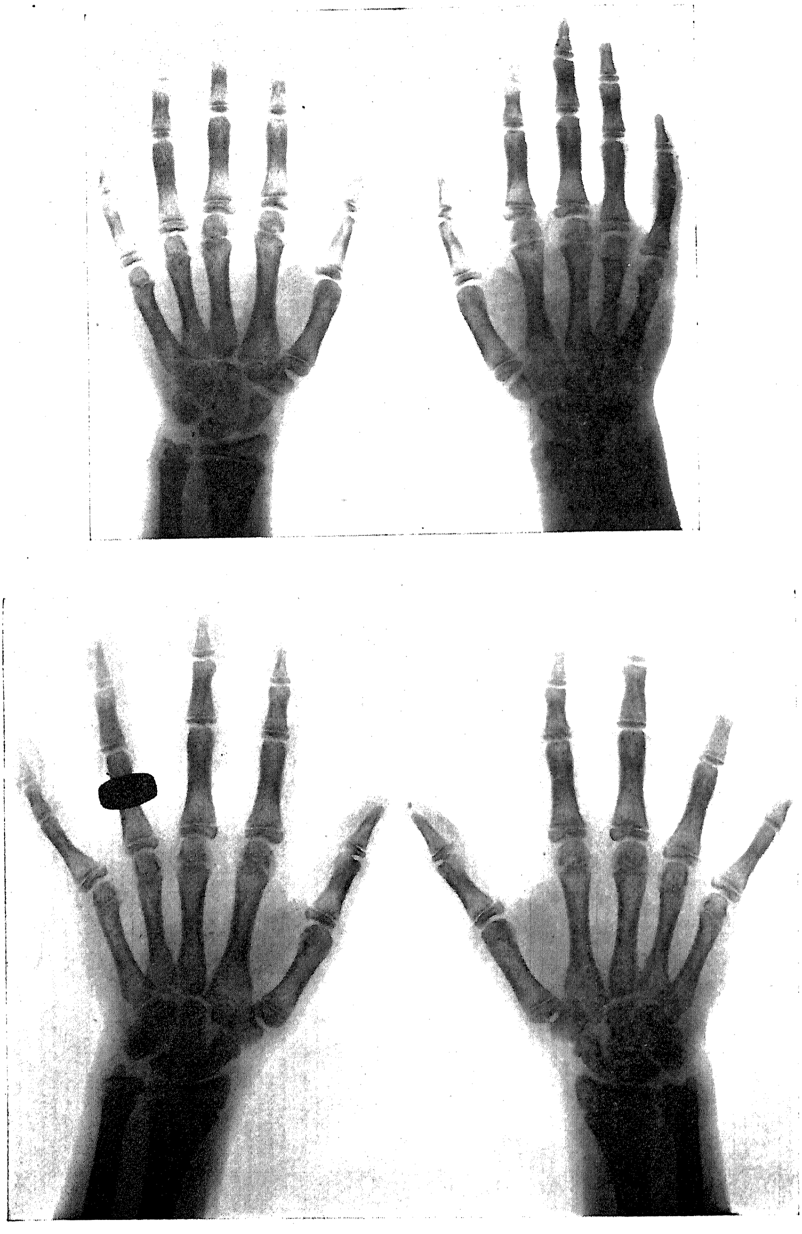
b. *Method of Finding the Area of the Bones of the Wrist.* At first attempts were made to measure the perimeter of the individual bones by means of a map tracer and protractors. This method was soon discarded and a method of tracing the outlines on millimeter cross section paper through an illuminated frosted glass plate was tried and also discarded. The tables in this section of the *Study* give the measurements as found by means of the planimeter (Photograph 11) with which the area of surfaces of irregular outline can be determined with accuracy. The accompanying photograph (12) shows the development at the beginning and at the end of the two year interval for one boy, No. 8376 (John) (Photograph 12). In 1918 the total exposed area of the seven bones was



Photograph 11. Planimeter: Instrument for Measuring Area of Carpal Bones



Photograph 12. Comparative Study of John at 11 Years 11 Months and at 13 Years 10 Months



Photograph 13. Eldon, Aged 12 Years Five Months and 14 Years Six Months

1110 sq. mms. and just two years later, 1920, the total area was 1832 sq. mms. In this case there was marked growth in the area of each bone and in the total area also because of the appearance of the pisiform (116 sq. mms.) after the two year period.

All original X-ray photographs have been reduced in these cuts from natural size by means of a uniform scale which makes the photographs of this *Study* comparable.

Further examples of the differences in the development of the wrist bones at various ages are contained in a series of comparative observations on No. 8370 (Eldon) (Photograph 13) and No. 8376 (John) (Photograph 12) for the year 1918 showing that in physical growth No. 8376 (John) is advanced, being both taller and heavier; in the anatomical development of the seven observable bones of the wrist No. 8376 has a larger projected surface area for bones separately and for all of the bones collectively. The same differences are observable in the photographs for 1920; in physiological development No. 8376 (John) was post-pubescent in 1918 and No. 8370 (Eldon) pre-pubescent; in chronological age No. 8376 (John) is six months younger than No. 8370 (Eldon). These data demonstrate that No. 8376 (John) is the older boy anatomically, although chronologically six months the younger.

c. *Names and Description of the Carpal Bones.* In the adult there are eight carpal bones in the wrist. The first proximal row includes from the radial toward the ulnar side, the *scaphoid,** the *semilunar,* the *cuneiform* and the *pisiform;* the second row, the *trapezium, trapezoid,* the *os magnum* and the *unciform.* Exceptionally, other bones may occur. The *pisiform* of the first row is, *en masse,* practically nothing but a sesamoid bone, independent of the flexor carpi ulnaris, resting on the palmar of the cuneiform and having no share in the mechanics of the wrist except as giving attachment to a part of the anterior annular ligament. The first proximal row, therefore, consists really of the first three bones mentioned, which are joined into one flexible piece by the interosseous ligament. The upper end of this combination bears an egg-shaped articular surface for the wrist joint, to which all three bones contribute. Its lower side has a concavo-convex outline, the concavity receiving the inner two bones and the convexity bearing the outer two of the second row. The latter consists of four bones connected by liga-

* The Piersol nomenclature has been adopted in this *Study.*

ments; the *trapezium* for the thumb; the *trapezoid* and the *os magnum* for the next two fingers; and the *unciform* for the ring and little finger. The dorsal side of the carpus is slightly convex, and the palmar deeply concave, forming by its middle, the floor of a deep canal, reached by the anterior, annular ligament which runs between bony elevations on each side of the carpus. A small depression for ligaments can be seen on well-marked bones near their edges on the dorsal and palmar aspects.

(1). The *scaphoid,* or boat-shaped bone, is the largest and most external of the first row. The *scaphoid* articulates with five bones: the *radium, semilunar, trapezium, trapezoid,* and *os magnum.*

(2). The *semilunar* receives its name from its outline when seen from the side, the proximal surface being convex and the distal deeply concave. The semilunar articulates with five bones: the *radium, scaphoid, cuneiform, os magnum* and the *unciform.*

(3). The *cuneiform* is frequently called the pyramidal on account of its form. The *cuneiform* articulates with three bones: the *semilunar,* the *pisiform* and the *unciform.*

(4). The *pisiform* has just been described above, p. 171.

(5). The *trapezium* is distinguished by an isolated facet on the distal surface for the metacarpal bone of the thumb. The *trapezium* articulates with four bones: the *scaphoid, trapezoid,* and the first and second *metacarpals.*

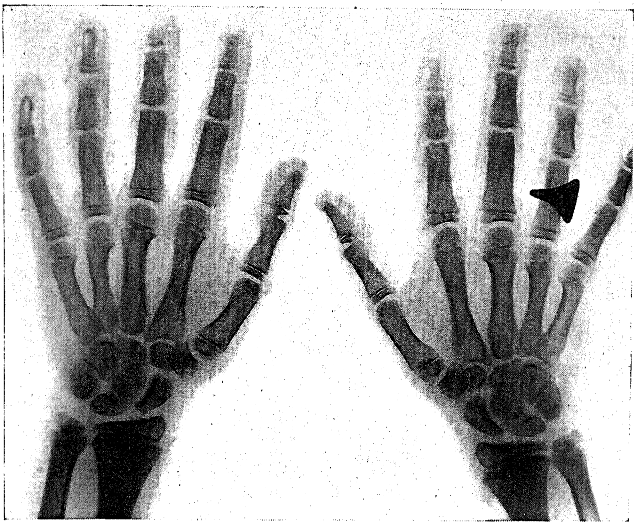
(6). The *trapezoid* is best recognized by the dorsal surface which is pointed distally where it progresses into the second metacarpal. This bone articulates with four bones: the *scaphoid, trapezium, os magnum* and the second *metacarpal.*

(7). The *os magnum* is the largest of the carpus and possesses a head, neck and body. It articulates with seven bones: the *scaphoid, semilunar, trapezoid, unciform,* second, third and fourth *metacarpals.*

(8). The *unciform* is distinguished by a prominent hook projecting from the inner side of the palmar surface for part of the annular ligament. This bone articulates with five bones: the *semilunar, cuneiform, os magnum,* the fourth and the fifth *metacarpal.*

These bones, with the exception of the pisiform, are clearly outlined in the roentgenograms (Photograph 14) No. 13,141 (Wilbur) of the writer's son at the age of 11, given here as illustrative of preadolescent development. The total exposed area in this case is 870 sq. mm.

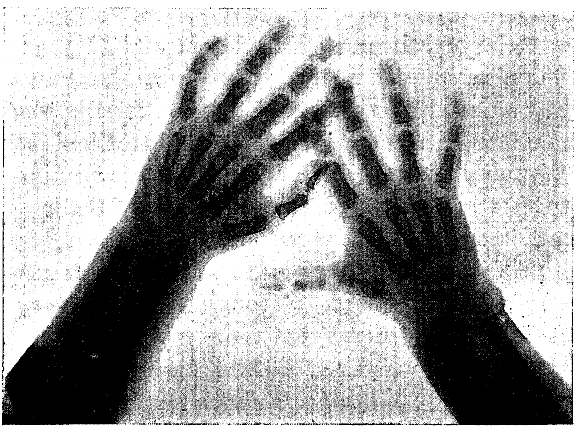
d. *The Development and Individual Variations in These Bones.* In early foetal life, centers appear for the above described bones, and also for many others which disappear or are fused with the usual ones long before the appearance of bones. An additional carpal depends either on the persistence and subsequent ossification



Photograph 14. Wilbur, Aged 11 Years

of centers that probably are lost, or on the separate development of two or more that fuse.

Ossification occurs from one center for each bone, but according to some authorities, the unciform and the scaphoid have two centers. The order of appearance of the first bones is not certain. The above cut (Photograph 15) No. 15,268 (Patricia) shows the development



Photograph 15. Patricia, Aged 1½ Years

of the writer's one and one-half year old girl. It will be noted that the three bones are present. Those of the proximal row, except the pisiform, are ossified by the end of the first four or five years chronologically, with a sex difference of nearly two years, the girls reaching this period first. These are followed by the trapezium and the trapezoid, so that by the eighth year the observable process has begun in all the carpals, save the pisiform, where it begins about the twelfth year. It may be noted that the seven are present in the previous case of the ten year old boy.

2. Comparative Areas for Different Ages

a. *Data for Comparative Study for 1918 and 1920.* The total areas of each of the seven bones: scaphoid, semilunar, cuneiform, trapezium, trapezoid, os magnum and unciform, for a limited number of children between 11 and 14 years of age, taken entirely at random from the University High School, are given in Table XXXVII where a direct comparison of the amount of development may be made for the two years' interval. The individuals in this Table are arranged chronologically and their respective heights, weights and individual bone areas from a dorsal view, with the increments of each, are given.

In all cases for the ninety-one bones included, there has been an increase, it will be noted, except in one instance for the scaphoid, one for the cuneiform, two for the trapezoid and one for the unciform, where there have been decreases due probably to a change in relative position.

A prominent characteristic of these 11, 12 and 13 year old boys and girls is the absence of the fifth, or pisiform, bone in all cases, except for the first subject in the 1918 series. That is, the appearance and ossification of this bone denotes an anatomical age beyond that attained by any of the individuals in this group save one. It will be noted that two years later, 1920, for three of the boys, fourth, fifth, and sixth respectively, the pisiform bone has made definite appearance, and for two of the girls, fourth and fifth respectively there has been an increase in area, although this is not very marked.

These results show in general that there is a positive correlation between the height and weight of a child, and the degree of anatomical development. Considering the area of the wrist bones, the taller, heavier boys and girls have the larger wrist areas in the

TABLE XXXVII

COMPARATIVE AGES, HEIGHTS, WEIGHTS, SURFACE AREAS OF THE CARPAL BONES AND STAGES OF PHYSIOLOGICAL MATURATION.

	Age at date of Radiograph		Height		Weight		Total		Trapezium		Trapezoid		Os Magnum		Unciform		Pisiform		Cuneiform		Semilunar		Scaphoid		Physiological Maturation
BOYS	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	
8372	11-7	13-6	139.2	150.5	34.9	48.5	1052	1355	129	142	97	116	290	329	206	226			97	129	90	187	142	226	Pubescence
8375	11-7	13-9	152.4		37.5		1271	1587	148	206	116	142	297	361	206	226			135	181	161	206	206	265	Postpubescence–
8381	11-9	13-11	141.2		33.5		942	1535	97	148	65	135	265	342	174	252			116	226	84	155	142	277	Prepubescence
8376	11-11	13-10	146.5		37.6		1110	1832	123	181	116	142	290	413	187	265		116	142	168	116	200	135	348	Postpubescence
8370	12-5	14-6	139.2		34.9		936	1348	103	174	65	90	232	265	187	232		90	90	135	116	155	142	206	Prepubescence–
8374	12-7	14-7	141.0	155.4	32.8	44.4	961	1284	110	148	71	123	277	303	181	194		77	116	116	90	129	116	194	Prepubescence
8378	12-11	14-11	147.6	168.5	34.0	55.5	1374	1826	116	196	116	142	329	413	226	303			168	219	194	200	226	355	Pubescence
8377	13-9	15-8	143.9	156.3	34.2	44.4	845	1129	71	84	45	71	219	297	155	239			84	90	129	123	142	226	Prepubescence
GIRLS																									
8426	11-3	13-3		144.3		36.1	1155	1510	155	168	129	135	232	342	206	252			77	181	148	161	206	271	Pubescence
8424	11-4	13-5		153.7		39.35	1155	1239	135	155	84	84	290		206				116		135		187		Prepubescence
8429	12-6	14-6		163		47.0	1090	1342	129	129	97	135	297	290	252	232	110	116	129	129	187	245	271	277	Postpubescence
8428	12-10	15-1		160.7		55.79	1503	1594	161	168	84	90	290	323	148	219	71	97	84	135	135	148	148	200	Pubescence
8425	14-2	16-3		151.8		42.64	1174	1387	146	168	90	123	252	310	200	213			148	174	148	148	194	252	Prepubescence

TABLE XXXVIII

HEIGHT, WEIGHT AND EXPOSED AREA OF CARPAL BONES

Boys No.	Age	Height	Weight	1 Trapezium L	1 Trapezium R	2 Trapezoid L	2 Trapezoid R	3 Os Magnum L	3 Os Magnum R	4 Unciform L	4 Unciform R	5 Pisiform L	5 Pisiform R	6 Cuneiform L	6 Cuneiform R	7 Semilunar L	7 Semilunar R	8 Scaphoid L	8 Scaphoid R	Totals L	Totals R	Totals L&R
16283	8-1	137	33	40	50	40	40	200	210	180	150			90	100	60	80	40	40	650	670	1320
16294	8-3	128.5	27.8	10	10	40	50	190	200	110	120			80	70	70	60	40	50	540	560	1100
16236	8-10	134	29.7	110	110	90	70	260	250	110	130			90	90	110	100	100	110	870	860	1730
16293	9-2	122	24.9	10	10	30	40	130	110	120	110			80	70	50	70	40	30	460	440	900
16296	9-2	127.5	28.3	60	50	40	40	160	150	120	130			100	90	90	80	80	70	650	610	1260
16233	9-3	140.4	30.8	60	40	70	80	230	230	150	170			80	90	90	120	50	60	730	790	1520
16290	9-5	135.7	32.5	100	110	70	70	220	230	120	140			110	100	110	120	110	120	840	890	1730
16220	10-4	152.5	49.5	100	100	80	50	210	240	120	150	40	40	90	120	100	140	90	130	830	970	1800
16222	10-8	143.5	35.5	150	130	100	80	270	240	170	190			110	100	110	110	150	170	1060	1020	2080
16237	10-9	136.6	33	90	130	80	60	260	260	230	170			110	150	130	130	140	170	1040	1070	2110
16214	10-10	139.9	31	40	60	30	30	190	210	140	140			80	90	40	60	90	90	610	680	1290
16239	10-10	134.9	27.2	70	80	60	60	170	130	180	140			80	90	30	20	3	30	593	550	1143
16280	10-11	140	31.7	100	100	90	70	210	230	180	150			120	130	120	110	110	110	930	900	1830
16206	11-0	134.4	28	60	80	70	90	240	250	210	190			110	100	110	120	110	100	910	930	1840
16291	11-3	127.6	31.5	120.	110.	60	70	210	220	190	180			110	110	110	110	100	110	900	910	1810
16216	11-4	147.8	44.3	110	90	80	60	250	230	210	190			100	110	110	120	110	90	970	890	1860
16215	11-6	141	30.1	110	90	60	80	230	240	250	220			110	110	110	100	120	100	990	940	1930
16235	11-6	140	28.5	100	120	90	80	250	270	190	150			110	130	110	100	90	120	940	970	1910
16285	11-7	140.4	32.1	110	100	90	100	210	210	180	190			100	110	90	100	110	120	890	930	1820

Continued on next page

Table XXXVIII, Continued

16208	11-10	147.5	40.7	130	130	80	90	260	240	180	160			140	120	110	90	100	120	1000	950	1950
16212	12-8	140	34	80	90	60	70	190	160	140	120			90	80	90	90	70	60	720	670	1390
16234	12-9	159	62.1	170	170	130	90	260	280	200	240	90	80	140	140	150	190	280	270	1420	1460	2880
16213	13-5	143.3	32	160	170	120	100	290	280	210	190			140	160	170	180	240	230	1330	1310	2640
																				19873	19970	39843
																		Average		864	868	1732

		Probable Error
Height-Area of Carpal Bones of right wrist coefficient	+.879	±.0275
Weight-Area of Carpal Bones of right wrist coefficient	+.755	±.052
Coefficient of Variation of Carpal Bones of right wrist	29.94	

Table XXXIX

HEIGHT, WEIGHT AND EXPOSED AREA OF CARPAL BONES

GIRLS No.	Age	Height	Weight	1 Trapezium L	1 Trapezium R	2 Trapezoid L	2 Trapezoid R	3 Os Magnum L	3 Os Magnum R	4 Unciform L	4 Unciform R	5 Pisiform L	5 Pisiform R	6 Cuneiform L	6 Cuneiform R	7 Semilunar L	7 Semilunar R	8 Scaphoid L	8 Scaphoid R	Totals L	Totals R	Totals L&R
16287	8-3	117	20.7	70	90	70	80	160	170	110	120	?	?	80	90	60	60	60	70	610	680	1290
16295	8-10	134.5	39.6	100	110	90	80	200	210	150	160			70	90	110	110	100	130	820	890	1710
16278	8-11	131.5	25.1	110	100	70	90	170	290	110	110			70	90	90	90	100	110	720	780	1500
16244	9-3	129	33	90	100	80	90	230	200	120	100	60	40	110	90	100	110	110	120	900	850	1750
16282	9-4	133.4	31.3	110	100	60	90	210	210	180	170			100	90	100	90	110	100	870	850	1720
16247	9-5	132	30	120	120	80	70	220	220	180	150	40	50	90	80	100	100	100	90	930	880	1810
16246	9-5	140	38.8	130	120	90	110	190	240	190	170			150	140	160	130	150	200	1060	1110	2170
16286	9-5	138.5	29.9	110	100	80	90	240	220	130	120			110	110	100	100	110	110	880	850	1730
16281	9-6	124.5	26	70	90	50	60	170	200	130	110			80	100	110	100	90	80	700	740	1440

Continued on next page

TABLE XXXIX, Continued

16279	9-6	138.2	28.1	110	100	100	80	230	250	150	170			110	110	100	110	90	90	890	910	1800
16292	9-9	133	25	90	80	60	60	190	200	110	110			80	90	70	70	60	60	660	670	1330
16231	9-10	134	25	80	90	50	80	160	180	140	160			90	80	90	80	80	100	690	770	1460
16249	10-2	127	24.1	100	110	80	70	210	190	190	190			110	110	100	110	90	120	880	900	1780
16205	10-8	145.5	31.7	150	110	80	80	210	250	180	180			140	130	130	130	150	190	1040	1070	2110
16240	10-8	131	25.4	80	100	70	60	210	210	140	130			90	90	80	70	90	110	760	770	1530
16245	10-9	146	41.8	170	190	80	60	240	190	180	210	70	60	120	120	160	130	150	120	1170	1080	2250
16248	11-1	138	31.8	150	160	100	120	200	210	130	170	50	80	110	140	120	140	140	160	1000	1180	2180
16243	11-1	148	33	140	150	80	110	210	240	180	150	60	50	100	100	130	120	150	170	1050	1090	2140
15302	11-1	145.6	39.5	120.	160	90	90	240	260	190	200			140	130	190	160	150	180	1120	1180	2300
16218	11-2	140.5	34.9	120	130	90	110	200	200	180	180			100	130	110	110	120	150	920	1010	1930
16232	11-3	144.5	36	110	90	90	80	190	230	160	160			100	110	110	100	150	120	910	890	1800
16207	11-3	138	29.6	90	100	70	90	260	220	190	140	50	50	110	100	120	90	100	120	990	910	1900
16219	11-4	146.4	51.5	180	150	130	120	210	240	190	150	90	80	140	130	130	110	190	230	1260	1210	2470
16210	11-5	143.6	36.5	130	150	90	80	260	280	240	190			150	140	90	120	210	210	1170	1170	2340
16209	11-11	148.8	36.7	130	110	120	100	240	240	130	120	60	40	110	130	110	110	140	140	1040	990	2030
16241	12-1	150	35.1	140	130	90	80	260	260	200	170	80	100	120	160	150	160	190	190	1230	1250	2480
3832	12-1	148.8	33.6	160	140	90	90	240	210	180	160	60	90	100	90	100	110	130	180	1060	1070	2130
16238	12-3	144.4	36.7	100	110	90	90	250	220	180	190			120	110	130	120	130	140	1000	980	1980
16242	12-5	145	35.5	130	110	50	80	210	230	150	190	60	60	90	80	100	90	120	130	910	970	1880
16211	12-5	148.5	41.1	190	170	120	110	280	240	210	220	90	80	120	130	170	150	190	200	1370	1300	2670
16288	12-9	145	35.5	70	60	70	70	140	140	110	120			90	100	90	100	60	70	630	660	1290
																				29240	29660	58900
																		Average		943	957	1900

		Probable Error
Height-Area of Carpal Bones of the right wrist coefficient	+ .729	±.0526
Weight-Area of Carpal Bones of the right wrist coefficient	+ .766	±.0464
Coefficient of Variation of Carpal Bones of the right wrist	12.698	

group. An exception is the fact that a child who ranked third for general physical development ranked fourth in 1919 for wrist area. The 1920 photograph, however, gave this individual third place.

b. *Data for Comparative Study 1920.* Making a comparative study of 31 girls and 36 boys of the Elementary School, and distributing the age, height, weight and exposed surface area of the eight carpal bones of the right arm and left arm, it will be noted in Table XXXVIII that on the average the total area of the bones of the right wrist is approximately the same as the area of those of the left, although there are great individual differences. It will also be noted that the relative area of the bones of the wrist of the girls is greater than that of the boys for the same chronological age. Girls are advanced not only in the development of surface area, but also in the formation of the pisiform bone, which is present in the case of 12 girls but only two boys. For the fourth girl, who is only nine years, three months of age, this bone is present. The youngest boy in which it has been noted is 10 years, four months, and the second boy 12 years, nine months, chronologically.

The coefficient of correlation between height and area of carpal bones of the right wrist is $+.729$, with a probable error of $\pm.0526$ for girls by the Pearsonian formula. For weight and area of carpal bones of the right wrist, the coefficient is $+.766$, with a probable error of $\pm.064$. The coefficient of variation of the carpal bones of the right wrist for the Pearsonian formula is 12.698.

For the boys the coefficient of correlation between height and area of carpal bones of the right wrist is $+.879$, with a probable error of $\pm.0275$; for weight and area of carpal bones of the right wrist, the coefficient is $+.755$, with a probable error of $\pm.052$. The coefficient of variation of the carpal bones of the right wrist for the boys, by the Pearsonian formula, is 29.94.

These results show a high positive correlation between height and the development of carpal bones, as indicated by the exposed surface area. The correlation with weight is also high. For height of boys the correlation is higher than for height of girls, and for weight, the coefficient for boys and girls is approximately the same.

These results also show that the coefficient of variability for boys is a little more than twice that for girls, which is in accord with the previous indications that boys vary more from eight to 13 years of age than do girls.

The previous photographs and the tabulated areas of these and the additional cases where the photographs have not been included, show that there are direct stages of growth of the carpal bones which may be expanded into an anatomical calendar for an individual boy or girl. At the present time the writer is formulating such an anatomical scale, using as a beginning of the standardization the photographs of the 280 children in the University schools.

c. *Conclusions*

I. The size and number of the carpal bones increase with age during childhood.
II. The development of the two wrists varies with individuals, but on the average there is no difference.
III. Girls at a given chronological age have a larger exposed surface area of the carpal bones of the wrist than have boys.
IV. Another evidence of the accelerated anatomical development of girls over boys is shown in the presence and development of the pisiform bone, which appears earlier during the pre-adolescent age with girls than with boys.
V. There is a high coefficient of correlation between height and area of the carpal bones (Boys +.879, Girls +.729) and also between weight and area of the carpal bones (Boys +.755, Girls +.766).
VI. Boys have a higher correlation than girls for height and area of carpal bones and about the same as girls for weight and area of the carpal bones.
VII. The coefficient of variation of the carpal bones is higher for boys than for girls (Boys 29.94, Girls 12.695).

3. The Anatomical Development of Disparate Twins

It has been stated universally, as far as the writer can determine, that the anatomical development of the carpal bones of twins of the same sex is the same at a given chronological age. For four years the writer has observed and measured his twin boys, Alan and Jervas. From birth, although much undernourished at the time, the one, Jervas, has not only been taller and heavier, but has constantly shown evidences of being more advanced physically and more mature mentally, though not so quick or bright in his mental reactions as the other, Alan. They are not identical twins and therefore

differ in appearance, temperament, disposition, motor reactions and intelligence ratings.

A. DATA ON PHYSICAL STATUS AND ANATOMICAL AGES OF TWINS

(1) *Alan and Jervas.* The accompanying reproduction of the physical examination measurement card gives the physical status

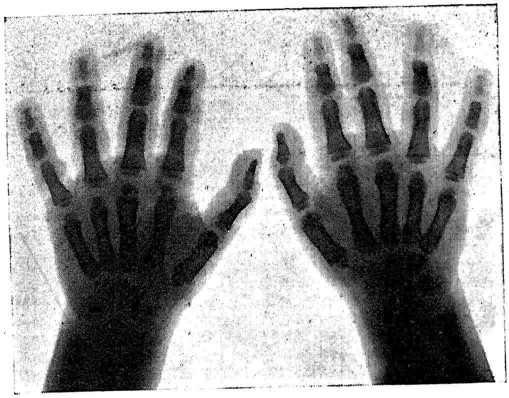
Name	Jervas	Alan	Robert	Richard	Sarah	Samuel
Place of examination	Iowa City	Iowa City	Iowa City	Iowa City	Iowa City	Iowa City
Date of examination	3-9-20	3-9-20	7-19-20	7-19-20	7-20-20	7-20-20
School year or grade						
Age	3-10	3-10	4-6½	4-6½	10-8	10-8
HEIGHT Standing	103.2	99.1	104 5	104.5	143 5	144 0
Sitting	61.2	57.5	58 7	57 5	76.9	74.5
LENGTH Span of arms	102 0	92 5	100 5	105 0	140 5	144.2
Shoulder—elbow	L 20.8 | R 20.9	L 19.5 | R 19 6	L 20 5 | R 21 0	L 22.4 | R 22 4	L 29.6 | R 29.5	L 29.7 | R 29.8
Elbow—finger tip	L 27.5 | R 27.5	L 25 6 | R 25.8	L 27 5 | R 27 0	L 27 9 | R 27 7	L 38 4 | R 38.5	L 39 3 | R 39 2
Knee—table	L 29.8 | R 29.9	L 28.7 | R 28.5	L 31.1 | R 31 1	L 30 8 | R 30.8	L 44 7 | R 44 9	L 45.5 | R 45.5
Face (chin-glabella)	15.2	14.7				
WIDTH Shoulder	25.5	25.0	24 0	24 7	32 4	31 5
Hips	19.0	18.5	18.3	18.2	25.5	25 3
Face	12.0	11.4				
DIAMETER Head (Anterior-posterior)	17.6	16.8	16 8	17 0	18 2	19 4
Head (transverse)	15.1	14.5	13 5	14 0	13 4	15 0
Head (height)	13.9	13.4	12 2	12.1	12.2	13.7
Chest width	18.3	16 6	17 8	18 2	20.1	21 9
Chest depth	13.5	13.3	13 4	14 2	15.9	15.8
CIRCUMFERENCE Head	52.0	51.0	49.0	50.0	51.5	55.5
Chest	54.5	53.5	53 0	55.5	61 8	63 8
WEIGHT	17.1	15.4	17.7	17 2	35.4	34.7
INDICES. Sitting—standing	59.3	58.0	56.2	55.0	53 6	51.7
Cephalic—index	85.8	86.3	80.4	82 4	73 6	77 3
Chest—index	73.8	80.1	75 3	78.0	79 1	72.1
Weight—height	.166	.155	.169	.165	.247	.241
Measured by	B.T.B.	B.T.B.	B.T.B.	B.T.B.	B.T.B.	B.T.B.

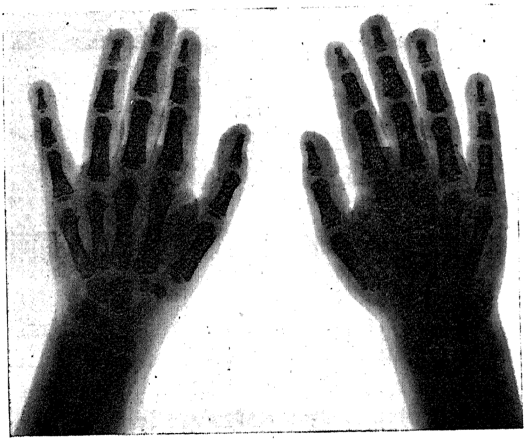
Chart LIV

of the two at the age of three years, ten months. It will be noted that Jervas exceeds Alan in all measurements, this relationship having existed, approximately, from birth. Both are now well developed, being close to a standard norm in their measurements and weight-height indices.

The larger boy, Jervas, was apparently further along in his anatomical and physiological development at birth, due, it may be, to a superior number of cells, even at this early age. Whether this is due to certain dietary factors or to the differences in the efficiency of the two organisms in utilizing the diet, or perhaps to their pre-natal positions, the writer does not know. He maintains that the one twin is anatomically and physiologically in advance of the other, presenting as further evidence, two roentgenograms at the chronological age of four years and two months.

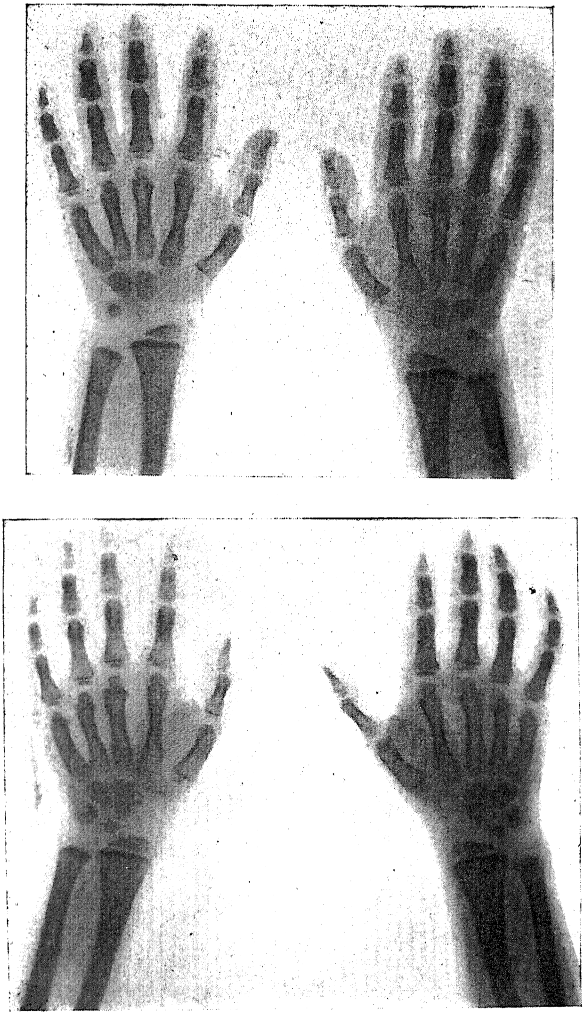
These X-ray photographs (No. 15,154 and No. 15,155) made originally natural size, show striking and significant differences It may be seen at once that for Jervas (17) the ossification of the





Photographs 16 and 17. Alvan and Jervas, Aged Four Years, Two Months

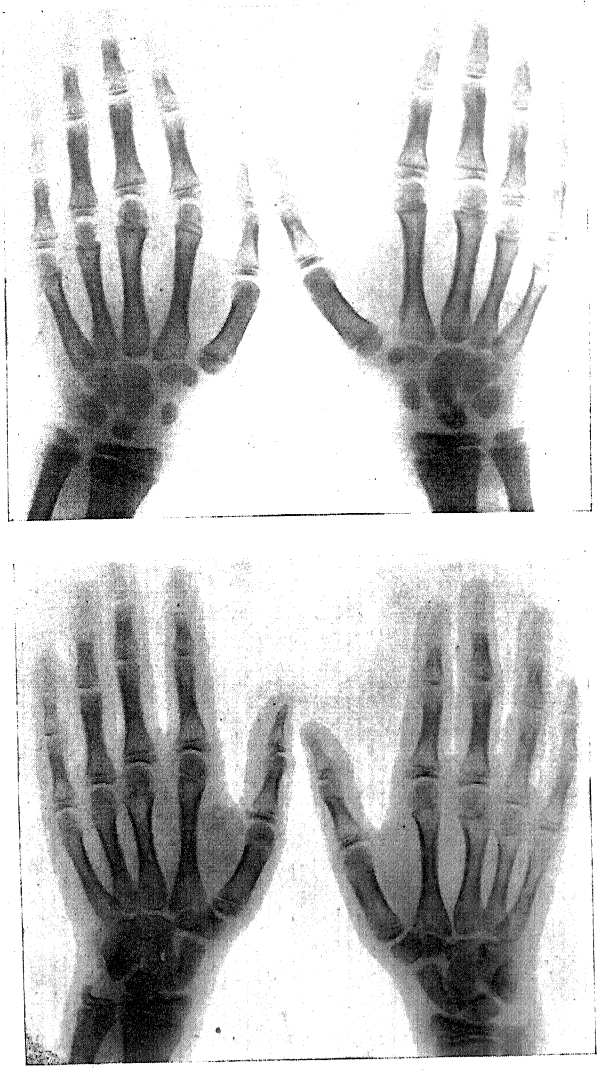
seven carpal bones is apparent, while for Alan there is no apparent center of ossification for the last three: trapezium, trapezoid and scaphoid, unless in the hand to the right the trapezium is making its appearance. It will also be noted that for Jervas the lower epiphysis of the radius is slightly more developed than for Alan, (16) with the diaphysis line a little clearer for Jervas. A significant difference in degree of development of the two boys may be noted in the presence of all of the epiphyses of all of the phalanges for Jervas and of the proximal ends for the first row for Alan, with beginnings for the second and third rows, particularly on the right.



Photographs 16 and 17. Alan and Jervas, Aged Four Years,

hand. The lower epiphyses of the ulna are not present for either twin. The total area in square millimeters for the exposed area of Jervas' carpal bones is 760.8, and for Alan, 303.3.

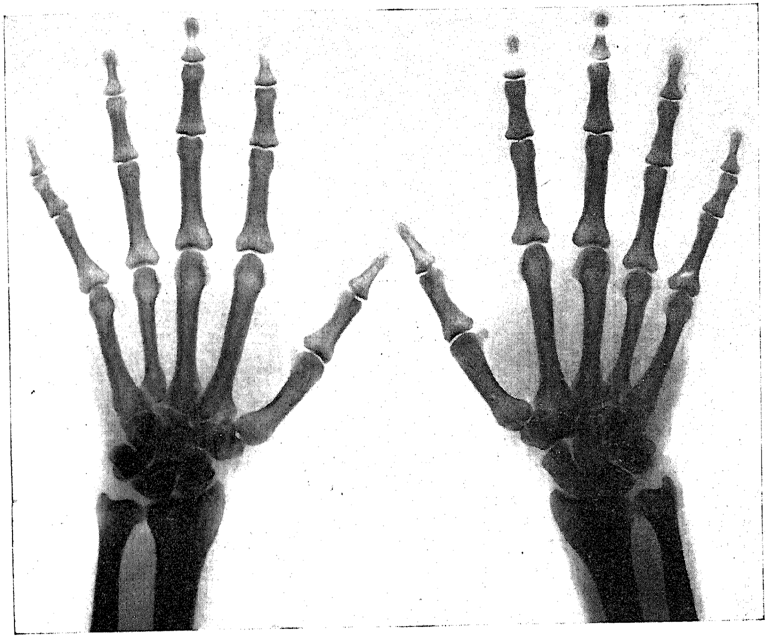
The former, Jervas, has, according to the writer's judgment, reached an anatomical age of 5½ years, while Alan has attained approximately four years of age anatomically. On the basis of the accelerated development of carpal bones and on account of his

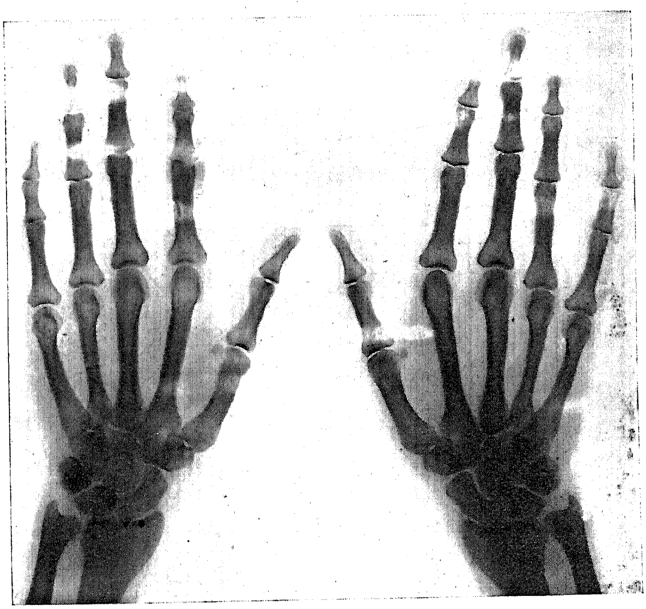


Photographs 20 and 21. Samuel and Sarah, Aged 10 Years

superior stage in maturation, Jervas has been sent to the University Elementary School this year (October, 1920), where he is with older children and is progressing satisfactorily.

(2) *Robert and Richard.* For comparison the physical measurements and roentgenograms (Photographs (18 and 19) No. 15,285 a





Photographs 22 and 23. Celia and Lorne, Aged 18 Years

TABLE XL

COMPARATIVE SURFACE AREAS OF THE CARPAL BONES OF TWINS IN SQUARE MILLIMETERS

BOYS AND GIRLS

			Trapezium		Trapezoid		Os Magnum		Unciform		Pisiform		Cuneiform		Semilunar		Scaphoid	
			1		2		3		4		5		6		7		8	
	Names	Totals	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
15154	Alan	303.3					71.0	90.3	58.0	6.5			32.3	25.8	6.5	12.9		
15155	Jervas	760.8	12.9	25.8	32.3	19.4	135.5	122.6	83.9	90.3			38.7	58.1	71.0	38.7	25.8	5.8
15285a	Robert	335.6					71.0	71.0	64.5	71.0			25.8	32.3				
15285b	Richard	522.8		6.5			122.6	129.0	83.9	71.0			32.3	32.3	19.4	25.8		
15303	Samuel	1451.7	38.7	71.0	64.5	19.4	225.8	225.8	141.9	141.9			122.6	96.8	90.3	83.9	71.0	58.1
15302	Sarah	2335.6	96.8	116.1	83.9	71.0	296.8	251.6	200.0	206.5			135.5	141.9	167.7	180.6	193.6	193.6
15277	Celia	3019.2	148.4	161.3	129.0	148.4	341.9	316.1	225.8	238.7	103.2	116.1	141.9	135.5	167.7	200.0	258.1	187.1
15278	Lorne	3174.1	167.7	148.4	141.9	135.5	341.9	341.9	271.0	238.7	129.0	96.8	148.4	122.6	212.9	167.7	271.0	238.7

and No. 15,285 b), of two other twin boys, Robert (18) and Richard (19), eight months older but relatively smaller than the two previous boys (Alan and Jervas) are given. These two boys are the same in height and almost the same in weight and in appearance. In area of the carpal bones they are very close to each other, Robert having 335.6 square millimeters and Richard 522.8 square millimeters. These are supposed by many to be identical twins.

(3) *Samuel and Sarah.* For further comparison and as a definite illustration of the differences in anatomical age due to sex, the physical measurements (17) of two 10 year old twins—a boy and a girl—Samuel and Sarah (Photographs (21) No. 15,302; (20) No. 15,303) are given. Sarah is within five millimeters of being as tall as Samuel and is .7 of a kilogram heavier. For a girl she is further above the standard for her age than Samuel is for the boys' standard. For the next three years she should exceed Samuel in all measurements except those of the head.

The same anatomical acceleration is evident in the development of the carpal bones. All are present for both children except the pisiform. Samuel has a total exposed area of 1451.7 square millimeters, and Sarah an area of 2335.6 square millimeters, she being anatomically about two years in advance of her twin brother.

(4) *Celia and Lorne.* The two sisters whose radiograms (Photographs (22), No. 15,277 and (23) No. 15,278) follow are 18 years of age and they too are considered identical twins. In anatomical development of the carpal bones, Lorne (23) is in advance of her twin sister, having a total area of 3174.1 square millimeters, and Celia (22) 3019.2 square millimeters. Both girls have the pisiform present, which, as previously stated, does not appear until after entrance into adolescence.

B. CONCLUSIONS

Using the development of carpal bones as criteria of anatomical development, it has been discovered that:

I. Disparate twins of the same sex may differ to a marked degree both in the number and in the exposed area of the carpal bones at four, four and a half, and 18 years of age.

II. In the case of twins of different sex, the girl is accelerated to a marked degree over the boy at the age of 10 years.

CHAPTER VIII

PHYSIOLOGICAL AGE

1. The Age Distribution of Pubescence of Boys and Physiological Maturation of Girls

The subjects of physiological and anatomical ages have been confused in the literature, because neither has been investigated empirically beyond a limited degree, although both are full of fertile problems of great significance in the study of individual development. The direct applications of the meaning of these ages to physical, mental, pedagogical, social and moral development have been recognized to a very limited extent.

There is a wide range to be found in the physiological differences between boys and girls of the same chronological age, as will be demonstrated by the data following. Some boys reach pubescence at 11 years of age, others not until 16 years of age; some girls reach this period of maturity at 10 years of age or earlier, others not until 16 or 17. Boys and girls who mature early in these functions may be considered physically older than those of later maturation.

a. *Data for Boys.* In order to determine the wide range of chronological ages that characterize the stages of physiological growth which are entered into at adolescence, the writer and one of his advanced students at Johns Hopkins University, Charles F. Pennington, checked very carefully some material that was gathered under the direction of Dr. William Burdick and Dr. Brown on the ages of pre-pubescence, pubescence, and post-pubescence in boys. (28) In Baltimore 3600 boys of a "motor" type of development, that is, those taking part in athletics, were examined. These data were supplemented by those from a group of 1317 boys from 14 counties of Maryland, making a total of 4917 boys. With these particular children the criterion was that of pubescent growth and pigmentation of fine hair, which characterizes a very brief period of time marking the change from asexual to sexual life, when the ability to procreate is established.

It is found that the *pre-pubescent* boys range from eight and one-half to 16 years of age in the group of country boys, and from

nine and one-half to 17½ for the city boys. The *post-pubescent* ages range from 11½ to 24 for the country boys and 12½ to 24 for the city boys. For the *pubescent* stages the country boys range from nine and one-half to 15½, with the mode at 13½, and the city boys from 10 to 18, with the mode at 14. The country boys reach this period earlier than the city boys. At no age are more than 53 percent of the age group of the city boys pubescent or more than 40 percent of the country boys.

A method is now being formulated and carried out by the writer with the University of Iowa Junior High School boys, which indicates that pubescence is but a rough and inadequate criterion of the secretion of the sperm cell.

b. *Data for Girls.* For the girls the criteria were the first menstrual flow, enlargement of the breasts, the appearance of sub-

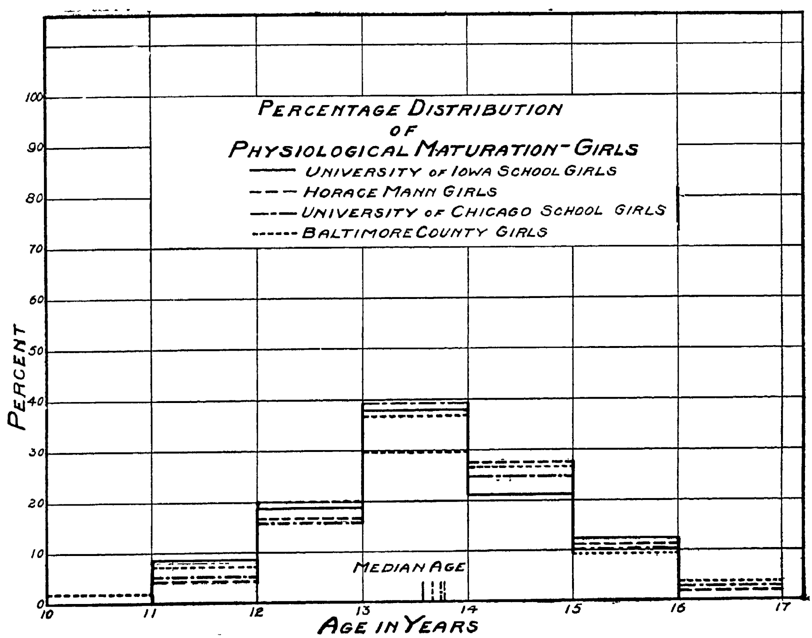


Chart LV

cutaneous fat, and axillary hair, as noted by the physician or nurse. Chart LV shows the age distribution in terms of percent of 47 girls from the University of Iowa Elementary and High School who had their first period of menstruation between the ages of 10 and 17

years; and a similar distribution for 151 Horace Mann school girls, 56 University of Chicago Elementary and High School girls and 134 Baltimore County girls from the Baltimore Athletic League. These data are accurate and represent typical groups of normal girls from the middle and upper class homes.

These data furnish satisfactory criteria for specific purposes, but

TABLE XLI

PERCENTAGE DISTRIBUTION OF PHYSIOLOGICAL MATURATION—GIRLS

1. University of Iowa Elementary and High School Girls

Ages	Cases	Percent	Median
11	4	8.51	13 years, 7 months
12	9	19.14	
13	18	38.29	
14	10	21.27	
15	6	12.76	
	47	99.97	

2. Horace Mann Elementary and High School Girls

Ages	Cases	Percent	Median
11	7	4.63	13 years, 9 months
12	25	16.55	
13	56	37.08	
14	42	27.81	
15	17	11.25	
16	4	2.64	
	151	99.96	

3. University of Chicago Elementary and High School Girls

Ages	Cases	Percent	Median
11	3	5.35	13 years, 9 months
12	9	16.06	
13	22	39.28	
14	14	25.00	
15	6	10.71	
16	2	3.57	
	56	99.97	

4. Baltimore County Girls, Maryland

Ages	Cases	Percent	Median
10	3	2.23	13 years, 8 months
11	10	7.46	
12	27	20.14	
13	40	29.84	
14	36	26.85	
15	13	9.70	
16	5	3.72	
	134	99.94	

other types of criteria are being worked out at the present time by the writer.

c. *Conclusions*

I. These data show that among children who are best developed from a physical point of view, there is no fixed age for physiological development as evidenced by the advent of pubescence or first menstruation. Adolescence does not begin at the same chronological age for all normal boys or for all normal girls, physiologically speaking. Children, boys or girls, may be of the same chronological age between 10½ and 16½ and differ in physiological age from one to four or five years and still be normal in physical development. The norm for pubescence is a distribution range, not an average chronological age.

II. At no age do as many as 40 percent of the groups mature.

III. There is a range in ages from 10 to 17 years for the age of first menstruation for normal girls.

IV. The girls from the country and from the smaller city (11,000 population) mature earlier than those from Chicago and New York, the median ages being respectively 13 years eight months, 13 years seven months, 13 years nine months and 13 years nine months. This conclusion substantiates the similar condition found for boys (28 p. 15).

2. Relation of Establishment of Maturity to Height of Girls

a. *Data.* In order to find the correlation from another angle between physical growth and the date of maturity (first menstruation) of girls, 151 Horace Mann girls and 53 University of Chicago high school girls between 11 and 17 years of age were taken, with the heights recorded at the time of the appearance of this physiological function.

It was found for the Horace Mann School, Columbia, that the seven girls who matured at 11 years of age had an average height of 148.2 cm., with the average or norm for the school at 140.39 cm.; the 25 girls who matured at 12 years of age had an average height of 152.1 cm., with the average or norm for the school at 146.22 cm.; the 56 girls maturing at 13 years of age had an average height of 155.3 cm. and the norm was 152.74 cm.; the 42 girls maturing at 14 years of age had an average height of 159.6 cm. and the norm was 156.97 cm.; the 17 girls maturing at 15 years of age were 158.5 cm.

in height and the norm was 159.35 cm.; and the four girls maturing at 16 or a comparatively late age were 163.2 cm., while the average for the group was 161.59 cm.

It was found that in working with the data for the 53 girls from the University of Chicago, those who matured at 11 years of age had an average height of 146.9 cm., while the average or norm was 141. The nine who matured at 12 years of age had an average height of 151.4 cm., with the average or norm for the school of 146 cm. The 22 girls who matured at 14 years of age had an average height of 154.7 and the norm was 153 cm. The 14 girls maturing at 14 years of age had an average height of 158.7 cm. and the norm was 157 cm. The six girls who matured at 15 years of age were 159.6 cm. in height and the norm was 159 cm.; and the two girls maturing at 16 or a comparatively late age were 161 cm., with the average for the group 160 cm.

b. *Conclusions*

I. These results show that girls who mature early are on the average close to the norm or below it. This is contrary to the current belief that early maturation is a sign of poor health.

3. Individual Growth Curves

a. *Data.* As soon as the wide range of pubescent development in terms of chronological ages is appreciated, the question arises, what underlying principle governs this period of physiological ripening and causes such differences in the phases of physical maturation. This may be made very clear by the following charts taken from a previous investigation (28), where the individual growth curves are given and the establishment of the period of first menstruation is indicated by heavy black dots. It must be recognized that a limited number of type cases are given, but they are all approximately normal. Since these are individual pictures, their validity is established and their worth of permanent value for future analyses. An application of scientific procedure will find several other conditions, such as heredity, social environment, climate, exercise and nationality as important determining factors. The problem here, as in the other sections of this *Study,* consists in finding the basic facts for further study of the normal child.

In the collected results in Chart LVI it may be noted that tall girls as a rule mature earlier than short ones. This was shown in the

writer's original study (27) by means of individual growth curves.

The individual growth curves in height shown in Chart LVI give some exceptions to this rule, but they demonstrate the law that early maturity means that growth is nearing completion in height

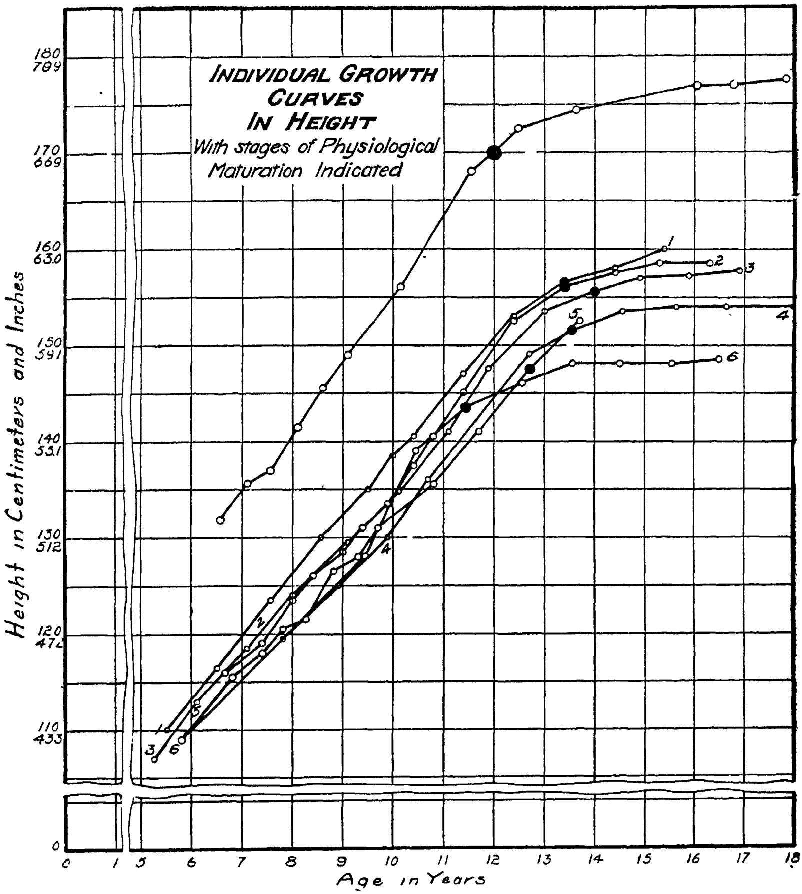


Chart LVI

as well as sex development. Individuals 4, 5 and 6 should normally mature late, but they matured relatively early and soon after this period there was a diminution in growth. This is very striking in the case of No. 6. Nos. 1, 2, and 3 matured approximately at normal age for their height, since none are tall

girls. The tall girls, 1a and 1b, show a striking contrast. The six girls are not only relatively small, but all have had serious illnesses. No. 1 had scarlet fever just before 13 years of age. No. 2 was anaemic throughout her school life, with lumbar curvature, intestinal disturbances and rapid and irregular heart. No. 3, a sister of No. 1, had scarlet fever at the same time, with poor posture during high school period. No. 4, in addition to having had many children's diseases, was very nervous. No. 5 had poor posture, and also had hernia and enlarged tonsils. No. 6 had enlarged glands of the neck and hip disease from a fall. No. 1a and 1b were healthy Chicago girls.

b. *Conclusions*

I. Tall girls of a fairly homogeneous group, as a general rule mature earlier than short ones.

4. Relation of Maturation to Growth

a. *Data.* The relation between the cessation of growth and the advent of sex maturity may be shown by a study of the average annual increments of growth between nine and 18 years of age. For the girls who matured at 11 years the increment of growth increased rapidly from nine to 11 and dropped rapidly almost to the one centimeter point at 14. For those girls who matured at 12

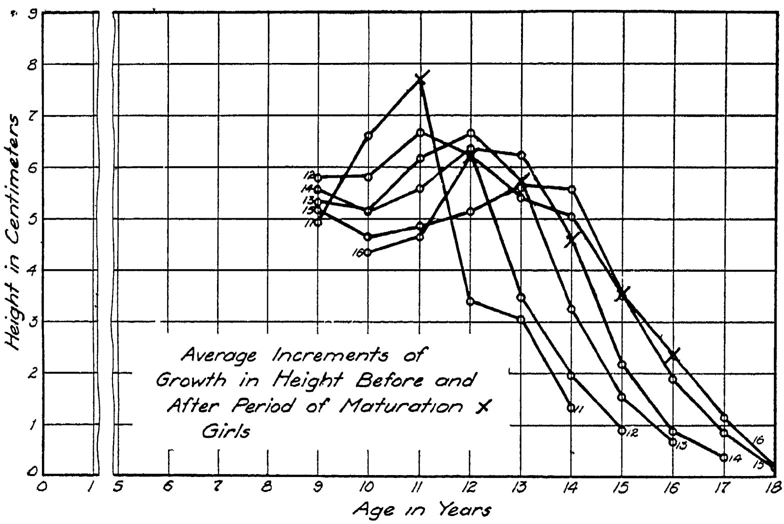


Chart LVII

years of age, there was an increase in the average increment until 11, then a slight drop and after 12 a rapid cessation until 15, when it was below the one centimeter increment. For those who matured at 13 there was a slight drop at 10 and an increase until 12, then a drop to less than one centimeter at 16. For those who matured at 14 there was a slight drop until 17, at which age the average is less than one centimeter. For the 15 year old girls there was a relatively high increment until 14 years, when there was a rapid decrease to less than one centimeter at 17. For 16 year old girls the rapid drop also began at 14 years and reached the minimum at 18 years of age.*

* Data from Horace Mann, University of Chicago and F. W. Parker Schools.

Photograph 24. Four children of the same chronological age (11 years), with different physiological ages. Katherine, Dorothea, Siegfried and Wilbur

b. *Conclusions*

I. Early maturity is followed, as a rule, by a rapid cessation of growth in stature. For girls who mature at 11, a rapid decrease in annual increment follows until 14, where there is less than a centimeter of growth. For those who mature at 12 a rapid decrease in increment follows until 15, when there is less than a centimeter of growth.

II. For girls who mature at 13 or later, the decrease in increment begins in the year previous to maturation, and reaches one centimeter or less three years later.

III. The decrease in yearly increment is more prolonged for girls who mature late.

IV. There is a positive correlation between physiological stages of maturation and anatomical age, as evidenced by height, weight, and the development of the area of the carpal bones.

5. Applications of the Concept of Physiological Age

Six distinct applications of the concept of physiological age in child development may be cited here:

a. *To Physical Training.* Physiological age has a direct bearing on physical training and directed play. Not only do children naturally play with boys and girls of their same physiological age, but the types of games in which they participate are dependent upon the stage of physiological maturity. It would be justifiable to arrange physical training schedules in schools on the basis of physiological age, giving boys or girls of the same physiological age similar types of exercise. On the average, girls are older physiologically than boys.

b. *To Stages of Mental Maturation.* Physiological age is, the writer believes, directly correlated with stages of mental maturation. The physiologically more mature child has different attitudes, different types of emotions, different interests, than the child who is physically younger though of the same chronological age. While a child may be precocious intellectually, and have a high intelligence quotient and pass beyond its chronological age in the development of certain mental traits, other types of traits indicative of mental maturity may be undeveloped.

Another experimental study just completed shows that the mental age of the individual bears a direct relationship to the physiological age as indicated by height and weight. The results show

that at each chronological age the physiologically accelerated boys and girls have a higher mental age than those of the average or below the average physiological age. The girls, when classified on this basis, show a higher mental age for a given chronological age than do the boys. Girls are on the average mentally older than boys.

c. *To School Progress and Promotion.* Physiological age has a direct bearing on pedagogical age, as many of our schools are beginning to recognize. The larger and physiologically more mature child may be able to do certain types of school work better, although of inferior ability in specific traits which have been greatly emphasized by school curricula. No child should be promoted or demoted without taking into consideration his or her physiological age. Girls may be expected to progress more rapidly than boys.

d. *To Industrial Work.* There should be a direct relationship between physiological age and the age at which boys and girls enter industrial work. Child labor legislation should take into consideration the physiological development of the boy or girl as well as his or her chronological age and school standing. Some children are sufficiently mature physically to meet the requirements of an age limit of 14 or 16, while others are immature and in a stage of physiological growth where more school training, more physical training and more opportunity for physical development are essential.

e. *To Social Adjustment.* That there is a direct relationship between social age and physiological maturity needs only to be mentioned to be evident. Some girls at a given chronological age are sufficiently mature to meet the social conditions which may arise, while others are not. It is apparent that in dealing with children, especially delinquents, between 10 and 18 years of age, there is a tremendous problem involved which rests directly on the physiological age of the individual. Girls face this problem earlier on the average than do boys. In a particular case it may mean a social misfit for life with another child involved, or the individual may be subject to remedial social training and development.

f. *To Moral and Religious Awakenings.* The commonly observed periods of moral and religious awakening in children, particularly at 12 to 16 years of age, show that there is a close relationship between physiological age and religious development, with girls preceding boys.

PART IV

CHAPTER IX

HISTORICAL ORIENTATION

1. Introduction

a. *General Summaries of Literature on Growth.* During the past two centuries there have been many valuable scientific investigations in physical growth, but only a few sustained efforts have been made to make a comprehensive survey of the field, aside from reviews from particular angles. A portion of the literature on growth is summarized in Roberts' (663) *Manual of Anthropometry,* 1878; Sack's (681) dissertation, 1892; Topinard's (822) *Anthropology,* 1895; Burk's (136) *Growth of Children in Height and Weight,* 1898; Macdonald's (490) *Experimental Study of Children,* 1897; Daffner's (193) *Das Wachstum des Menschen,* 1902; Ernst and Meumann's (241) *Das Schulkind in seiner körperlichen und geisten Entwicklung,* 1906; Vierordt's (846) *Anatomische und physikalische Daten und Tabellen,* 1906; Weissenberg's (865) *Das Wachstum des Menschen,* 1911; Baldwin's (27) *Physical Growth and School Progress,* 1914; Martin's (505) *Anthropology,* 1914; and Hrdlička's (405) *Physical Anthropology,* 1919.

b. *International Scope of Contributions.* The present status of the scientific literature on physical growth shows many countries contributing, among which are America, England, Scotland, Ireland, Canada, Australia, France, Norway, Denmark, Sweden, Spain, Holland, Belgium, Switzerland, Italy, Germany, Austria, Russia, Poland, Finland, China, Japan, and the Philippine Islands.

The largest amount of scientific material and probably the best, has been gathered or formulated in the United States, England, Germany, France, Russia and the Scandinavian countries, with little from South America and from China directly. Repeated attempts have been made to secure available material through correspondence and conferences. In England the investigations have usually included large numbers of individuals, principalls adults, and have been undertaken for practical ethnological, sociological,

military and hygienic purposes. In Germany, where more detailed analytical work has been done with children and adults, the point of view is that of the physiological development of the individual. In Russia the physiological and pedagogical points of view have also predominated; in Italy the criminal and pedagogical; in China and Japan the pedagogical; while in Norway, Sweden and the Netherlands the anthropological and pedagogical motivations have been the determining factor. In America, where large numbers of children have been measured and compared in different parts of the country, the work has been done primarily by physicians, anthropologists, anthropometrists, psychologists and educators.

2. Early History of Growth Studies

a. *General Fields Included.* In making an historical survey of the scope, methods and purposes of investigations of physical growth, it may be noted that the scope includes the study of infants, both prenatal and postnatal, children, adults, and occasional comparisons between animals and human beings. The group method has predominated, where different groups of individuals have been measured for different ages and the averages obtained have been supposed to represent consecutive growth periods in the same individual. The literature shows very few studies on a considerable number of cases by the individualizing method. The earliest of these was published by Vahl (832), 1884, followed by that of Landsberger (456), 1888, who measured 37 children for a period of seven years. Then followed Wiener (879), 1890, who measured his four sons consecutively from birth through childhood. In 1910 King (437) presented measurements of his two boys, in one case for six years and in the other for three years. There have been other studies of individual children by Mrs. W. S. Hall, (342), by Major, by Karnitzky (422), Wissler (883), Moon (534 and 535), Boas and Wissler (100), and by Camerer (144-148). Godin (299), 1910, presented the results of four annual measurements on 100 boys. Matthias (507), 1916, investigated the effect of physical exercise on 737 Swiss athletes, each measured three times a year from the age of 16 to 22. Porter (618) in 1920 had obtained weight data on a large number of Boston public school children who had been weighed from 1909 to 1919. The investigations of Baldwin (27 and this *Study*) follow the individual growth curves for a number of physical traits on

several hundred children from various sections of the United States for periods of 10 to 12 years.

b. *The Influence of Sculpture and Painting on the Study of Growth.* Scientific anthropometry arose mainly from the desire to find the best proportions for the beautiful forms that artists wished to represent. Although no specific references have been found in Greek and Roman literature to actual anthropometric work among these peoples it is evident that the sculptors must have measured the human body in order to make the exact copies of the victors in the athletic games whose statues were customarily placed in temples and public squares and served as examples or norms of perfect physical development. It is known that artists were in the habit of frequenting the gymnasia in order to study the physique of the youths and maidens who were exercising there. Phidias is said to have used twenty models in order that the most beautiful parts of each might be assembled into one figure.

The artistic tradition was carried on by Dürer's (226) folio published in Nüremberg, 1528, which contained much material on human proportions. In 1654 Elsholt (232) published at Padua his *Anthropometria,* the first modern work on anthropometry, in which were included pictures of the perfect body and illustrations of anthropometric instruments. Audran (21) published a study at Paris, 1683, which gave the diagrams and measurements of twenty-five famous statues. Bergmüller (55) 1728 wrote one of the early treatises on anthropometry. David (201) 1798, also published material about the famous statues of antiquity.

The historical association of the artistic movement with the interest in anthropometry generally is shown by the fact that in 1770 Sir Joshua Reynolds called attention in an address delivered before the Royal Academy of Fine Arts to the differences in the measurements of the human form from childhood to adult life. Camper's (157) 1803, works may serve as an example of the earlier modern anatomical treatises. It is to Quetelet, who coined the word anthropometry, that credit should be given for the first scientific study of physical growth. In 1830 were published the results of these first investigations in which the artistic procedure was joined to the new scientific method of empirical measurement and induction. The artistic tradition was continued in such work as that of Fock (256) 1850, who posited Apollo Belvedere as the model for human proportions, and of Story (786) 1866, who gave a detailed study of

parts of the body with many allusions to the work of classical scientists, while Schadow's (696) *Polyclet*, 1834, carried the study of human proportions a step further in that it took account of sex and age and gave actual life sizes.

3. Methods and Technique

A. LACK OF UNIFORMITY IN METHODS

Since these early studies a vast amount of work has been done in the field of experimental measurements and physical tests. Unfortunately there has been a great lack of uniformity in methods of measuring, standardization of instruments, units of measurement, parts to be measured, topographic points to be accepted, methods of recording data, methods of estimating ages, time of day for measuring, and intervals for repetition of measurement. The English authorities and many Americans have used the inch divided into tenths as a unit measure, although many investigators have used the eighth of an inch. In practically all other countries, the metric, or French system, has been used, with obvious advantages, since the system is the scientific standard used in most countries and in all other departments of science; it is a decimal system and is easily translated into the English system.

There has also been great confusion in the selection of the parts to be measured, since this should be dependent upon the purpose for which the measurements are being taken—that is, the value to the individual examined, the value to anthropology, the value for the science of physical measurements, the value for an educational program, or the value for correlations with psychological traits. What is needed at present is a standardization of all these factors and a definite statement of the purpose for which each investigation has been made.

B. THEORETICAL DISCUSSIONS AND GENERAL TREATISES ON GROWTH

Many contributions to the theory of anthropometry and numerous considerations of technical questions are to be found in extensive investigations which are listed in later sections of this historical orientation. The summaries of the literature on growth listed in Part VI also contain much material of this kind. The first important special contribution to theory was Galton's

(282) short account of an anthropometric laboratory and his (283 and 284) discussion of anthropometric percentiles, 1884 and 1885. Boas (83) in 1894 contributed to the theory of measurements and in 1904 published his discussion of variable quantities (92). In 1894 Pearson (575) wrote on Galton's percentile method. Boas and Wissler (100) 1904, issued their study on statistics of growth which was a continuation of Boas' (91) 1902 statistical study of anthrometry. Weissenberg's (860) anthropometric principles and methods appeared in 1904. As early as 1893 Titchener (821) made a noteworthy distinction between anthropometry and experimental psychology. The latest contribution to this field is Hrdlička's (406) articles on the anthropometry of the living, in 1919. The recent works of Schiötz (707), 1919, in Norway and of Őrum (569), 1919, in Denmark, make special contributions to statistical method.

Among the writers of general treatises bearing directly on growth, those that are most significant are Thoma (812 and 813), 1882, Frölich (275), 1896, Ellis (231), 1896, Donaldson (213), 1896, Chamberlain (165) 1900, Thorndike (817) 1901, Buschan (139) 1909, Griffith (321) 1909, Boas (96-98) 1912, Kirkpatrick (440) 1917.

C. MANUALS

A description of the methods of making physical measurements with tables of norms and an account of the general growth process has been published in manual form by Gulick (328), 1892, Megret (516) 1895, Hitchcock, Seeley and Phillips (390) 1900, Hastings (356) 1902, and by Seaver (743) 1909. Books on statistical methods which are applicable to anthropometric work are Davenport's (197) *Statistical Methods,* 1899, and Thorndike's (818) *Mental and Social Measurements.*

D. GROWTH FORMULAE

Probably the greatest development in anthropometric methods of recent years has consisted in the extended use of mathematical expressions for various growth phenomena. Beginning with Quetelet in 1836, investigators who have had at their disposal a collection of various measurements of the body on different individuals for an extended series of years, permitting them to calculate the yearly increments, have attempted to express their growth curve by means of a mathematical equation. Since this pioneer work, the

derivation of formulae has aided materially in the development of a science of human growth and also in coördinating and correlating the work of the various investigators, especially in reference to total and partial growth of the body. It should be noted that all of the formulae are only approximations, for growth varies in total and partial bodily proportions at different chronological ages, in different sexes, in different races, at different stages of physiological maturation, at different times of the year, and under various environmental and nutritional conditions.

(1) *Rate of Growth.* One class of these formulae has been designed *to express the normal rate of growth throughout life;* that is, to give the shape of the curve for relationships of particular measurements such as height or weight. Such formulae rest on the assumption that the normal individual has a certain growth capacity or growth energy at birth. Consequently the value of any measurement at any time of life can be obtained by solving an equation in which certain other values are known. For example, instead of comparing the actual weight of an infant with the norm for its age, the weight it should have at that age may be calculated by filling in the formula. Some writers have constructed tables of norms by making a few determinations and interpolating values that seem to conform to the growth curve as they find it. Accurate formulae, including relationships for more than a few years, have been impossible, particularly previous to this *Study,* since individual growth curves for childhood have not been available.

Quetelet (626-634) used both classes of formulae, concluding that the weight of the body in the various years of life is proportional to the fifth power of height. The formula is:

1. For weight. $g = G \sqrt{\frac{{}^{5}}{L^{5}}}$

where

g = weight to be found; G = birth weight; l = height;
L = birth height.

The increase in weight has also been worked out theoretically by Finkelstein.

2. For height increase Quetelet used the formula:

$$y - \frac{y}{1000\ (T - y)} = a\,x - \frac{t + x}{1 + 4/3x} \quad \text{where}$$

x = age in years; y = height corresponding to this;
t = height of new-born; T = height of adult;
a = yearly increase between ages 4-16.

An elaborate but somewhat fantastic and inaccurate scheme was devised by Liharzik (474), 1858. The result seemed to indicate that all measurements show that growth takes place in epochs and that in each period of a single epoch the same increase takes place; *i. e.* if L is the height at birth, this increases in the first month by λ in the second and third months together by λ; in the fourth, fifth and sixth months by λ. The second epoch begins from the twenty-second to the twenty-eighth month, from the twenty-ninth to the thirty-sixth month, and so on, to 171 months, the increase in each case being still λ. The third epoch has a similar increase. Liharzik's division into epochs and periods with the corresponding months of life was:

I. Epoch 6-5/6 cm. increase												
Period	1	2	3	4	5	6						
Months	1	3	6	10	15	21						
II. Epoch 6 cm. increase												
Period	7	8	9	10	11	12	13	14	15	16	17	18
Months	28	36	45	55	66	78	91	105	120	136	153	171
III. Epoch 2 cm. increase.												
Period	19	20	21	22	23	24						
Months	190	210	231	253	276	300						

Liharzik did not work out his formula mathematically but Raudnitz (648), 1892, had Liharzik's measurements worked over by a mathematician who devised formulae.

Zeising (906), 1858, believed that growth in height took place in such a way that the parts of the body were related to each other in the ratio of the *golden section.* The formula is:

$$x : y : : y : (x + y).$$

Another early mathematical derivation of a growth formula, but without observational material, was made by Kaiser (420), 1875. Attempts have been made to give mathematical expression to the general bio-chemical law of growth. Robertson, (664) 1897, published a growth formula derived from the results of Quetelet and of the British Anthropometric Committee. It was found that any particular cycle of growth obeys the formula:

$$\log \frac{x}{A - x} = K (t - t_1)$$

where x = amount (in weight or volume) of growth which has been attained in time t; A = total amount of growth attained during the cycle; K is a constant; and t = time at which the growth due to the cycle is half completed. The author shows that the formula holds true for plants and their elements as well and thinks that growth is an autocatalyzed process in both inorganic and organic life.

The belief in the parabolic character of the growth curve has led

to a considerable amount of discussion. Wiener, 1890, (879) reported continuous measurements on his four sons. Inspection of these measurements led Wiener to the belief that between the ages two and 12 the growth curve is part of a parabola which can be analyzed to give the general formula:

$$y^2 = a\,(x + b).$$

According to this formula, the axis of the parabola is parallel to the abcissa and its vertex is located to the left of the middle of the system at a distance represented by *b*, the values of the constants *a* and *b* varying somewhat with different individuals. Hall (341) 1895, in a study of the principles of growth by rhythms concludes, "When the vertical dimensions of the human body are undergoing acceleration of their rate of growth, the horizontal dimensions undergo a retardation of their rate of growth, and conversely."

In 1903 von Lange (460) corroborated Wiener's findings in regard to the parabolic characteristics of the curve from two years to the beginning of puberty, but tried to draw an analogy between the laws governing growth and the general laws of motion.

Reinus (651) 1915, in a dissertation under Pfaundler's direction, made an attempt, with different sets of measurements drawn from the literature on growth in height, to find a parabola that would fit the observed facts. This attempt was unsuccessful. Pfaundler (590) 1916-17, working over the data of Friedenthal on the average growth curve of the typical male, found a formula which would express growth in height from birth to the end of puberty. This is:

$$x = n\,y^3$$

where x = the age in years dating from the time of conception; y = the height in meters; and n = a constant about 4.75 in value. This formula means that age is proportional to the third power of height. By mathematical procedure, Pfaundler also found that when height and density remain constant, weight during the growing period is also proportional to age.

Another type of formula has been developed by workers on the caloric requirements of infants, since the amount of milk to be given at each feeding is to be computed on the basis of the "theoretical weight" for any particular age. Daniels and Byfield (195) 1919, for example, find the theoretical weight by using the following adaptation of Finkelstein's rule: birth weight − (600 × age in months) − 300 = weight for first six months. Birth weight − (500 × age in months) = weight for second six months.

(2) *Relationships in Growth.* A second class of formulae *expresses the relationship between two physical traits.* The use of these formulae, or better, "indices" is based on the assumption that there is a constant relationship between the growth of the body in the two traits concerned, as for example, in height and in weight. A few investigators have constructed curves showing the value of these indices for each year of life and the curves have been used for diagnostic purposes.

Boulton (108) 1876, though offering no formula, stressed the constant relationship between weight and height and foreshadowed the modern point of view that weight alone is no criterion of normal development. It is the relation of the two expressing robustness that is important. Porter (617) 1896, also emphasized the importance of the height-weight ratio. Ranke (644) 1894-1900, used the following formulae:

Weight-height index $= \frac{W}{H}$; Vital-height index $= \frac{V}{H}$

Leg-height index $= \frac{L}{H}$; Head-height index $= \frac{h}{H}$

Enebuske (235) 1892-94 assembled or devised formulae for the following relations:

Total strength-weight index $= \frac{TS}{W}$; Power index $=$ $TS\,\frac{LC}{W}$; Vital strength-weight index $= \frac{LC}{W} \times \frac{TS}{W}$

Oeder (555-557) 1909 and 1910 combined height and weight into an index. Weissenberg (865) 1911, compared thirteen measurements with height and used nine other indices expressing the relations of various parts of the body to each other.

Gaertner (278) 1912, developed a formula to express the relationship of height and weight, computing thereby a table for the normal weight of adult men and women (for each 1 centimeter increase in height).

Tuxford (826) 1917, has used a formula in which the variable factors are:

For boys: $\frac{\text{Weight in grams}}{\text{Height in cms.}} \times \frac{381 - \text{age in months}}{54}$

For girls: $\frac{\text{Weight in grams}}{\text{Height in cms.}} \times \frac{384 - \text{age in months}}{48}$

The results are empirical and fall within childhood ages. This writer states that the average for normal children should fall within 990 and 1010.

Matusiewicz (508) 1914, also wrote on the height-weight coefficient.

An index relating height and arm span was discussed by Knoop (444) 1918. Feri (252) 1893, developed a relationship between length of trunk and weight.

(3) *Total and Partial Growth in Volume.* A recent trend has been the development of formulae which should not represent merely linear relationship but should take into account the fact that the body is a three dimensional object. As early as 1879 Meeh (514) began a study of regions or parts of the body to be measured and of the body and total volume, and in 1895 (515) a relationship was shown between the volume of a single part of the body and total volume in infant and adult life.

Among formulae designed to introduce the factor of the third dimension is the "index ponderalis" of Livi (482) 1899. This is:

$$\frac{100 \quad \sqrt[3]{P}}{L}$$

where P = weight and L = height.

Another formula takes into consideration chest circumference as well as height and weight. This was introduced by Pignet (598 and 599) in 1900 and 1901 as the "coefficient du robusticitié." It has been widely used in the German and French armies. The formula is:

$$N = H - (B + K)$$

where N = the numerical index; H = height in centimeters; B = chest circumference in centimeters; K = weight in kilograms. When the weight and chest circumference are especially large compared with the height of the individual, the size of the index is small. On the basis of this fact, Pignet divided individuals into seven classes, ranging from the group containing the best developed with a coefficient of 1 to 10, to the group including physical weaklings with a coefficient of above 35. Rarely there occurred cases of over development where the coefficient was zero or negative. Mayet (511 and 512) 1906 and 1912, applied Pignet's formula to children. A report (10) on its use with Chinese and Indian subjects was made in 1916.

Rohrer (671) 1908, emphasized the significance of the quotient obtained by dividing the weight in grams × 100 by the cube of the height in centimeters. This was called the "index der Körper-

fülle.'' Bardeen (32) 1918, used a modification of Rohrer's formula, computing an ''index of build'' by dividing the weight in pounds by the cube of the stature in inches and multiplying the quotient by 1000. This formula was applied to the data of Baldwin (29), using as a general presupposition the assumption that *a pound of the body equals a three inch cube.* As is well known in physics, the volume of objects of the same shape but of different sizes varies as the cube of their diameters. Bardeen says: ''We reach the same result by dividing the weight in pounds by the cube of a tenth of the height or by the thousandth part of the cube of the height in inches. Therefore, as a height-weight index in the study of stature, weight, and body-form, we have adopted the weight of the body in pounds divided by the thousandth part of the cube of the height in inches.'' Rohrer's formula has also been employed by Berliner (56) 1920. Davenport (199a) recommends dividing the weight by the square of the height. He unfortunately based his results on Quetelet's inaccurate data of ten cases for each age and the untenable presupposition that short children are on the average stockier. The formula is a very promising one.

In accordance with the same conception of the cubical character of the body, von Pirquet (600) 1913, stressed the height-weight index as a criterion of the individual's nutritional condition. Another formula introduced in 1916 by von Pirquet (601) used the relationship of weight and sitting height thus:

$$\frac{\sqrt[3]{10G}}{S}$$

where G = weight and S = sitting height.

Although a full consideration of formulae for volume, specific gravity, density and cubical content of the body is undesirable in this survey, mention should be made of the work of Braune and Fischer (117) 1889, Mies (525) 1899, Wengler (869) 1906, Kastner (423) 1911-12, Pfaundler (589) 1911-12, (590) 1916-17.

(4) *Growth in Surface Area.* It is beyond the scope of this investigation to enter into a full account of the subject of the *surface area* of the body of normal growing children; but reference should be made to a few of the most significant studies, since there is a direct relationship between cutaneous surface and volume and a direct relationship between volume and linear growth and also weight. The surface varies with shape and volume. A student of Vierordt, Meeh (514) 1879, assuming that individuals were similar

in shape, and disregarding the differences between infants and adults, proposed the formula:

$$S = K W 2/3$$

where S = area; W = weight; and K = a constant based upon the experimenter's data. Seaver (743) 1909, found that a determination of the superficial area of a person which may be of value for special purposes may be found in square centimeters:

$$\text{Sq. cms.} = 11 \times \sqrt[3]{\text{weight}^{-2}} \text{ (in grams)}.$$

A general survey of work on the determination of body surface was given by Lissauer (480) 1903. Other significant studies are those of von Hösslin (398) 1888, Miwa and Stoeltzner (529) 1898, Sichoff (753) 1902, Maurel (510) 1904, and Lassablière (465) 1910. Moleschott, Vierordt and Lissauer calculated areas topographically on geometrical principles or used coverings of millimeter paper or tinfoil and measured the amount of covering used, or covered the body with color and transferred the color to absorbant paper and calculated the amount of paper covered. Pfaundler (590) 1916-17, used plaster strips in a similar manner. He (589) also gives a good historical resumé. Howland and Dana (400) 1913, have used for infants the formula:

$$Y = 0.483X + 730$$

where Y = body surface in square centimeters; X = weight in grams. Du Bois and Du Bois (220 and 221) 1915 and 1916, and Sawyer, Stone and Du Bois (694), disregarding weight and volume, have made the most extensive, empirical studies, summarizing the literature of the field. They allowed for the spherical nature of the head, the cylindrical form of the neck, legs and arms, and the cylindrical or spherical tendencies of the trunk at different ages. Benedict (50) 1916, used the silhouette photographs similar to the method worked out by others. Bardeen (32) 1918, using linear measurement, weight and volume, assumed the specific gravity of the body to be 1.000 when dealing with centimeter-gram units and compared the body with a square cross section block. The formula is:

$$S = K \left(2 \frac{W}{H} + 4 H \frac{W}{H}\right)$$

where S = surface-area, W is weight in grams, H height in centimeters, and K is a constant. In the formula, $\frac{W}{H}$ gives the surface area of each end of the block, $H \frac{W}{H}$ the surface-area of one

side of the block. K has to be determined from the observed surface-area of the individuals, of given height and weight. If inch-pound units are used, one must substitute W × 27.68 for W in the formula given above if the same specific gravity is assumed as in this formula, or W × 27 if one assumes the same specific gravity assumed in dealing with volume. K varies with age, sex and nutritional condition of individuals. For example, for a six months infant, K = 1.53. Bardeen also gives the *regional distribution of surface areas.*

(5) *Graphic Representations of Growth.* Closely associated with the introduction of formulae expressive of total or partial growth has been the development of graphic diagrams and charts designed to show on a comparative basis with standards, the physical condition of the person or group of persons. Graphic anthropometry probably originated prior to Quetelet, who showed in graphic form the binomial distribution curve with the mean for specific measurements. Among the investigators who have developed "charting" of physiological traits are: Galton (283 and 284) 1884, 1885, who first showed the significance of percentiles; Stieda (781) 1882-83, whose work was largely theoretical; Sergi (748) 1886, who developed an anthropological cabinet; Bertillon (59 and 60) 1889 and 1896, and Muller (542) 1887, who were particularly interested in the identification of criminals. Jeanneret and Messerli (418) 1917, developed a photo-anthropometric method.

In America the early pioneer work in graphic anthropometry through charts and synoptic tables was developed and fostered by Sargent (689 and 692) 1886 and 1893, and Hitchcock (378-388), whose contributions appeared from 1887 on, Gulick (328-330) 1892 and 1893, Hartwell (350-352) 1893, Jackson (415 and 416) 1892 and 1893, Hastings (354 and 356) 1898 and 1902, and Seaver (743) 1909.

In France, Topinard's (822) *L'anthropologie*, with its excellent chapters on craniology, appeared in 1895. In Germany there was Friedenthal's (273) *Uber Wachstum*, 1912 and 1913, and two articles by v. Lange (459 and 460) 1896 and 1903.

Among others who have developed graphic charts designed for score cards or norms of physical measurements are Wood (888-893) 1890-1918, Hanna (345) 1893, Kellogg (425) 1893, v. Pirquet (600) 1913, Baldwin (29) 1919, Children's Bureau (168) 1918, and Bardeen (33 and 34) 1920.

4. Anthropological Investigations

A. NATIONAL CONTRIBUTIONS ON RACIAL DIFFERENCES

No attempt will be made in this section of the historical summary to give an exhaustive account of the anthropological studies on the physique of different races, but note will be made of the most significant investigations classified according to their place of publication, and the tables in Part V will give the data for comparative studies in racial development for the reader who is concerned with this phase of human development.

(1) *English.* Numerous important contributions have been published in England. Brent (118) 1844, made before the British Association for the Advancement of Science a comparison of men at different epochs in different countries. In the following year tables were presented (119) showing the height, weight and strength of man. Quetelet (629 and 630) 1846 and 1847, presented a study of some Ojib-be-was Indians, in 1848 (631) a discussion on the Egyptians, Romans and Indians and in 1854 (632) a study of the proportions of the black race.

Thomson (816) in 1853 published some observations on New Zealanders. In 1861 Beddoe (44) discussed the physical characteristics of Jews before the Ethnological Society of London, in 1870 (45) reported on the stature and bulk of men in the British Isles, and 1897-98 made a study with Moore (537).

Other important articles are by: Shortt (751) 1863, a comparative study of Europeans and some natives of India; Brigham (124) 1866, a study of Chinese. Farr (245) 1880, and Galton (284) 1884-85, data on the English race; Forbes (257) 1884-85, on the Kubers of Sumatra, Garson (290) 1890, further data of the anthropometric committee on which Farr and Galton worked; Haddon (337) 1897, comparative study on the inhabitants of Barley, Hertz; Gregor (318) 1897, comparative study of Galloway folk in Wightshire and Kirkenbrightshire; Grünbaum (326) 1897, on the physical characteristics of the inhabitants of Barington and Foxton in Cambridgeshire; Taylor (803) 1897, on the inhabitants of Checkheaton, Yorkshire; Brown (127) 1897, inhabitants of Clara Island, Ireland; Meyers (545-547) 1905-08, on Egyptians; Rasmussen (647) 1908-09, Eskimos; Orensteen (566) 1915-17, detailed individual studies of Egyptian prisoners from Cairo; Craig's (180) earlier use of this same Egyptian material in 1911; Talbot (799) 1916,

some central Sudan tribes; Seligman (747) 1917, physical characters of the Arabs.

(2) *German.* In Germany there have been fewer anthropological studies made primarily for the purpose of finding racial differences. Many anthropometrical observations have been made by members of expeditions for other scientific purposes. As examples, may be mentioned the work of Schwarz (735) 1862, and Wullerstorf-Urbair (896) 1857-59. Other studies have been made by Schultz (728) 1845, on Russian Jews and Negroes; Scherzer and Schwarz (699) 1859, Vienna; Ecker (227) 1876, Baden; Kirchhoff (438) 1892-93, comparative studies of the Germans; Stratz (787) 1898, Java; Hagen (338) 1901, Chinese; Ranke (642) 1906, Brazil; Lipiec (478 and 479) 1912, Jews; Schiff (701) 1914, Jews from Jerusalem; Weissenberg (859, 863, 866) 1895, 1909, and 1914, Armenians and Jews; Radlauer (638) 1914-15, the Somali; Schlaginhaufen (711) 1914, New Guinea; Drontschilow (218 and 219) 1914 and 1915, anthropological studies on Bulgarians; Spitzer (770) 1915, Krakau; Bartucz (37) 1916, Magyars.

(3) *American.* The Americans have recently been less interested in racial differences than in pedagogical anthropometry. The first significant study in America was that of Dickson (207) 1857, continued in 1858 (208), who made detailed statistical observations on the height and weight of the southern men. In 1866 (209) a report showed that the new American race growing out of an almost unlimited mixture of other races, compared favorably with all the races of the Old World in every point of physical development, and showed no deterioration. Other studies were made by Bowditch (112) 1890, Massachusetts women; Boas (80, 81 and 85) 1891 and 1895, physical characteristics of the Indians, 1905 (93) anthropometry of central California, 1911 (95) descendants of immigrants, 1920 (102) anthropometry of Porto Rico; Hrdlička (401 and 403) 1898 and 1899, comparison of white and colored children and 1908 (404) observations on Indians; Bobbitt (103) 1909, Filipinos; Bean (42 and 43) 1914-15, American, German-American and Philippine children; Nicholas (550) 1919, a history of physical anthropology in Mexico.

(4) *French.* In France the interest in racial differences has been a recent development. Convy's (176) 1907, study was followed by Verneau's (843) 1916 work on Africa; Roudenko (678) published in Paris 1914, a study of different portions of Siberia.

In 1915 Pittard published three studies (604-606) on the Jews and Turks, on the Jews of Dobrodja and on the races of the Balkan peninsula.

(5) *Norwegian.* The principal Norwegian investigators of this subject are A. Daae (187) 1906, and H. Daae (187-189) 1909.

(6) *Italian.* In Italy studies from the anthropological point of view have been made by Bresciani-Turroni (120) 1913, on different regions in Italy; Guiffrida-Ruggeri (296) 1915, Oriental Africa.

(7) *Russian.* Among the important Russian studies are those of Blagovidoff (76) 1886, on the Mongolian Asiatic races; and Szepessi (798) 1897, on the Magyars. So many Russian dissertations within this field are inaccessible that no direct comparison can be made here.

(8) *Japanese.* Almost the only Japanese investigations undertaken primarily from the anthropological point of view are those by Kubo (452-454) 1912-1918, on the Chinese and on the Koreans.

(9) *Dutch.* In the Netherlands contributions have been made by Nieuwenhuis (551) 1903 and Witt (884) Netherlands.

(10) *South American.* The beginning of anthropometric work in South America is represented by a study of Cassenilli (162) 1917-18, on Argentina.

B. GROWTH OF ANIMALS AND MAN

Few studies have been made on the relationship between the growth of animals and human beings, but those that have been made are significant and full of scientific data. An early contribution was published by Menard (517) 1885. Donaldson (214) 1906, made a comparison between the white rat and man with respect to the growth of the entire body, and further studies are in progress; Friedenthal (267-272) 1909 and 1911, published curves on the growth of man and other animals, indicating great similarity between man and the anthropoid ape, and in 1914 summarized much work in his large volume (274). Haustein, 1916, (359) discussed devices for representing the growth of man and animals by measurements and drawings.

C. MILITARY STUDIES

The measurement of recruits of the army and navy has always held a prominent place in the development of physical anthropometry, and several million individuals have been measured in various countries.

France. Considering first the army, it is found that the first modern study was that of Villermé (847) in 1829, who made a careful study of the height of conscripts in the French service. In 1863 Boudin (107) published a comparative ethnological study, later followed by Chervin (167) 1896, Merz (520) 1901, and Kirkoff (439) 1906.

England. Aitken (2) 1862, published studies on the growth of the young British soldier; the British Army Medical Department (125) reports for 1894, 1895, 1896, and 1901, contain important material. Myers' (546) measurements of Egyptian recruits appeared in 1906. *A Physical Census in England and its Lesson* (11) which appeared anonymously in 1918, analysed the data on drafted men in the recent war.

America. One of the earliest military studies in America was Elliott's (230) analysis in 1863, of the physical measurements of soldiers in the American army of the Potomac. The most exhaustive studies in America were those of Gould (311) 1869, Baxter (39) 1875, Sternberg (779) 1893, and Beyer (64) 1896. French (265) 1885, and Dun (225) 1887, made a special study of the police standard. In 1918 Hoffman (391) presented a study on men rejected for military service. In 1919 Ireland, Love and Davenport (412) showed the results of the physical examination of men sent to mobilization camps, and in 1920 Davenport and Love (200) discussed defects found in drafted men in the recent world war.

Germany. German military anthropometry is represented by a number of investigations from the time of Ranke (643) in 1881. He was followed by Ammon (7 and 8) 1890 and 1894, Hultkrantz (407) 1896, Brandt (116) 1898, von Schjerning (710) 1910, Kulka (455) 1912, and Drontschilow (218) 1914. Special interest has been shown in the possibility of using indices as means for the physical examination of recruits. Schwiening (738-740) 1908, 1909, and 1914, advocated the use of Pignet's formula, and Oeder (558) 1914, discussed his work. Eulenberg (242) 1910, found Pignet's formula unsuitable for individual cases. Ott (571) 1911, and Simon (760) 1912, used the formula, while Seyffarth (749) 1911, considered it useful for rapid surveys.

Russia, Italy, Norway, Denmark. Forssberg (259) 1897, Starkow (774) 1897, Yatsuta (899) 1914, made important Russian investigations. Livi's (481) Italian article appeared in 1894. In Norway

there is Koren's study (447), 1901; and in Denmark Mackeprang's (494) investigation, 1907-11.

Naval cadets. Among the important studies of naval cadets are those of Morskoi (540) 1871, Gihon (293) 1880, Cordeiro (177) 1887, Beyer (61-64) 1893-1896, Williams (881) 1902, and Solhaug (766) 1920.

5. Growth of Infants

The first studies in anthropometric measurements of infants were those of Roederer (670) in 1753, Clarke (172) 1786, and Pfannkuch (588 a) 1874.

A. TREND OF GROWTH CURVES

Quetelet's (628) comprehensive survey of human development in 1836 included the growth of babies. Just as this investigator failed to discover the sex differences in the growth of older children, owing perhaps to having determined too few points on the growth curve, so also there was no recognition of the exceedingly steep rise in the early part of the curve during infancy. Quetelet seems to have been under the impression that this curve was a straight line connecting three points for which measurements had been taken: birth, twelve months and twenty-four months. This belief in regard to the first year, at least, is expressed as follows in *Recherches sur le poids de l'homme aux differents ages,* 1833, where it states "Pendant la première année son poids s'accroit regulièrement, de telle sorte, qu'en un son poids a triplé."

B. POSTNATAL LOSS IN WEIGHT

After Quetelet's reports, the problem of determining the general trend of the growth curves was neglected for a number of years while investigators occupied themselves with the explanation of the so-called "physiological loss of weight" in the first few days of life. Chaussier is credited by many authors with having been the first to discover that infants lose weight for a few days after birth. These observations must have been made between 1815 and 1830, but nowhere in the literature is an exact reference given. One of the earliest accessible studies is by Hofmann (393) in 1849. In 1860 both Breslau (121) and v. Siebold (754) wrote on the subject. Important investigators who followed, giving particular attention to this problem, generally from a medical point of view, are: Haake

(335) 1862; Winckel (882) 1862; Gregory (319) 1871; Kézmarsky (434) 1873; Altherr (6) 1874, Krüger (451), Ingerslev (411) and also Cnopf (173) 1875, gave an historical resumé; Stoll (784) 1876; Wolff (886) 1883, and also Biedert (67) 1883, added to a mere record of the phenomenon some consideration of the factors that influence the change in weight. Wagner (852) 1884, and Townsend (824) 1887, continued the discussion of the cause of the loss. Schaeffer (697) 1896, presented a statistical analysis of causes, and Fourmann (262) 1901, a discussion of causation. They were followed in 1903 by Schulz (729); Fuhrmann (277) 1907; Heidemann (363), Hirsch (377), Rott (677), Pies (597) 1910; and Örum (568) 1914. Benestad (51 and 52) 1913 and 1914, published an excellent review of the literature and a classification of factors of causation under the head of insufficiency of metabolism. Robertson (665 and 666) 1914 and 1915, attributed the loss to mechanical shock. His work was followed by that of Bergmann (54) 1916, Schick (700) 1917 and Hammett (344) 1918, the last of whom found the loss to be a function of birth weight. Other recent writers are Kirstein (441 and 442) 1917 and 1918, Haverschmidt (360) 1917, and Ramsey and Alley (641) 1918.

Many of these writers noted simply the phenomenon of loss by daily weighing of infants. Others attempted to account for the loss by an analysis of the physical and mechanical factors influencing weight, and the development of a better technique of weighing with reference to time of day, consumption of food, loss of organic products, etc. As a lengthy discussion of these factors is beyond the province of this work, reference should be made to the thorough treatment by Benestad (52).

C. GENERAL VS. INDIVIDUAL METHODS FOR STUDYING WEIGHT AND HEIGHT

After the early interest in the problems of fluctuations in weight, the attention of scientific writers was turned to the determination of the general curve of growth for infants. Probably the first systematic attempt to find average weights for every month in the first year of life was made by Bouchaud (106) in 1864. This line of work was continued by Fleischmann (254) 1877, whose article is of interest historically as an early example of the "individualizing method" with its insistence upon following the same individuals throughout the period observed, instead of making a few determin-

ations and interpolating values according to some formula in the manner that diverted Quetelet from the main problem. The individualizing method occurs only very rarely in the literature. Most of the workers on this problem of the total growth curve have used the method of *averages*; many have combined males and females, and practically none give average deviations.

Early writers had noted as a characteristic change in the rate of growth a general slowing down, shown by a rapid fall in the curve of increments after the first year, and had emphasized the importance of sex differences. An early study by the individualizing method was made by Woronichin (894) 1880-81. In the study of the general growth curve, the technique of the individualizing method was developed to a relatively high degree by Camerer, senior. In 1880 Camerer (144) published a short study of infant weight; in 1882 he (145) extended Vierodt's collection of cases from the literature and added data from his own practice; in 1893 he (146) reviewed the results and in 1899 his son (150) presented a summary of 283 cases. In 1901 Camerer senior (148) published the original tables for 119 of these cases. Karnitzky (422) 1908 and King (437) 1910, also reported measurements by the individualizing method on particular children.

Other much less extensive studies by the generalizing method were published as follows: Odier (554) 1863; Uffelmann (830) 1881; Pfeiffer (591) 1884; Morse (539) 1886-87; Chaille (164) 1886-87; Petersson (588) 1887; Lorey (486) 1888; Voute (851) 1895-96; ten Siethoff (757) and Graanboom (312) 1899; Perret and Planchon (587) 1904; Ausset (22) 1904; Fleischner (255) 1906; Lascoux (464) 1908; Heubner (375) 1911 (general summary); Friedenthal (270) 1911; Mayet (512) 1912; Pooler (609) 1913; Robertson (669) 1916; Broudic (126) 1919; and Faber (244) 1920. A recent undated collection of measurements by Crum (185) contains fairly reliable assembled average standards beginning at six months.

The early literature contained very few studies on the height of infants. In 1860 von Siebold (754) gave the birth length, together with the weight, but it was not until 1881 that a table by Hess (374) included a few determinations of height in the continuous series of measurements of a child from birth to two years. Schenk (726) 1880 gave the birth length of 300 cases, and Mrs. Hall (342) 1896-97, gave height measurements for one case thoughout one year.

Camerer almost always reported height as well as weight in his studies. Fleischner (255) 1906, related weight to height and other measurements. Lascoux (464) 1908, Mayet (512) 1912, and Crum (185) gave height measurements. Breslau (122) 1862, was interested in sex differences in head circumference. Of special studies concerning the interrelationship of various measurements during growth, that of Zeltner (909) 1911, is an example. In 1914 Montague and Hollingworth (530) made a comparative study of the variability of the sexes at birth and found no inherent sex differences.

D. INFLUENCE OF NUTRITION ON GROWTH

In addition to these general investigations of growth in weight and height, a number of significant studies were made on the effect of special conditions, among which diet early received scientific consideration. The first work upon this phase of the subject seems to have been done by Coudreau (178) 1869. He was followed by Faye (247) 1874, and by Ahlfeldt (1) 1878. The individualizing method was used in this field by Camerer and Hartmann (153) 1878. Their work furnished determinations actually made (and in a few cases calculated) for every day of the first year of an individual infant's life. This new point of view is exemplified also in the study of Hähner, (339) 1880, who weighed an infant before and after each feeding to determine the exact amount of food taken, with the resulting effect on growth during the first year.

The problem of the relative advantages of breast and artificial feeding came to the foreground in such work as that of Russow (680) 1881 and Sakuragi (685) 1908. Philippson (596) 1913, gave weight curves for artificially fed infants, and Sieveking (758) 1914-15, published tables for both the breast and artificially fed. Contrary to Russow's findings in regard to the superior development of breast fed infants, Hillenberg (376) 1912-13, and Variot and Fliniaux (840) 1914, reported only a small difference between the breast fed and the articially fed.

For the numerous articles on the caloric requirements of infants, Oppenheimer's (565) 1901, may serve as an example. Other works on the relation between nutrition and growth have been published by Rübner (679) 1909, Mühlmann (541) 1910, Langstein (462), Meyer (522) and Schloss (717)—all 1912; Bamberg (31), Brady (115), Herman (367), Jaschke (417) 1913; Opitz (562)

1914, Schute (731) 1915. Within the last few years a fertile field of investigation has been opened by the discovery of the special growth-stimulating properties of certain diets. Hammett and McNeile (343) 1917, observed the effect of the mother's ingestion of dessicated placenta in hastening the infant's recovery from the postnatal decline in weight.

The work of Daniels and Byfield (195 and 141) 1919-20, showed the effect of the anti-neuritic vitamin in stimulating growth. Among general treatises on the relation between nutrition and growth processes, both normal and pathological, might be mentioned those of v. d. Bergh (53) 1893, Marfan (501) 1899, Judson and Gittings (419) 1902, Schloss (715-717) 1910, 1911, and 1912, and Langstein and Meyer (463) 1914. The handbooks of Holt (396) and of Griffith (321 and 323) have gone through numerous editions within the last decade.

E. PATHOLOGICAL CONDITIONS AFFECTING GROWTH

Studies of the effect of pathological conditions on height made by Variot (835-837) 1907 and 1908, showed that a "dissociation of growth" might take place with a continuous increase in height, although weight was seriously affected; Freund (266) 1909, corroborated this; Birk (75) 1911, found, however, that with very young children height was unfavorably affected. Stolte (785) 1913, and Aron (16) 1914, also found height to be somewhat affected, though less so than weight.

Hess (373) 1915-17 showed the effect of antiscorbutic diets on weight in infantile scurvy. Eddy and Roper (228) 1917, stimulated growth in cases of marasmus by the use of pancreatic vitamin. The work of Daniels and Byfield (195 and 141) 1919-20, has already been mentioned. At the present time it seems probable that a significant advance in knowledge concerning growth is shortly to be made in this field.

F. INFLUENCE OF SPECIAL CONDITIONS ON GROWTH

Among other special conditions whose relation to growth has been studied, are *dentition*—Woronichin (894) 1880-81; *military fitness of father*—Schmid-Monnard (718) 1892; *institution vs. family life*—Freeman (264) 1914; *season*—Bleyer (77) 1917; *war conditions*—Brüning (129) 1918, Pollak (608) 1918, and Hoffman (392) 1918.

A number of writers have reported birth measurements in relation to special problems. Among these are: *the age of the mother*—Hecker (361) 1865; Faye and Vogt (249) 1866; Stockton-Hough (783) 1885-86; Lange-Nielsen (461) 1918; *nationality*—Okamato (560) 1894; Robertson (667) 1915; *order of birth*—Siesel (756) 1905; *occupation and social class of parents*—Letourneur (472) 1897; Issmer (413) 1899; Fuchs (276) 1899; Weissenberg (861) 1908; Goldfeld (307) 1912; Peller (584) 1913; *length of pregnancy*—Astengo (19) 1905; Christofferson (170) 1905; Lutz (489) 1912; Kjolseth (443) 1913; *correlations of measurements*—Pearson (576) 1900; Peller (585) 1917; and Taylor (805) 1918.

Birth measurements have also been reported by Scanzoni (695) 1849, Veit (842) 1855, Hecker (362) 1866, Martin (503) 1867, Cnopf (173) 1871, Witzinger (885) 1876, Schütz (732) 1881, Spiegelberg (767) 1882, Kézmarsky (434 and 435) 1873-1884, Körber (446) 1884, Schröder (727) 1886, Mies (524) 1891, Miller (527) 1893, Sfameni (750) 1901, Warren (857) 1917.

G. FOETAL GROWTH

Considerable work has been done on foetal growth, but this problem is beyond the province of our present discussion and the reader is referred to Jackson (414) 1909, and Scammon's unpublished work.

6. National Contributions on Phenomena of Total Growth or Partial Growth

Studies on the general phenomena of physical growth as surveyed from the early work of Bird (74) 1823, may be differentiated into innumerable problems and sub-problems. In the main the object has been to determine how children and adults grow and what is the relation of the growth of different parts to the total growth of the body.

A. NATIONS CONTRIBUTING

(1) *Belgium.* As previously stated, the first attempt at an inductive study based on empirical material was that made by Quetelet, who selected ten individuals for each age and from whose data, published 1830 onward, a number of conclusions were drawn, many of which were untrue. Since Quetelet's time there has been

little continuation of the anthropometric interest except in the work of Schuyten (733 and 734) 1902-03 and 1919.

(2) *France.* In France Buffon's (134) wide interest in scientific subjects summed up in his *Oeuvres complètes,* published 1829-32, even led to some observations "sur l'accroissement successif des enfants." Guéneau de Montbeillard "mesuré de 1759 à 1776" is probably the first child mentioned in the literature to whom the individualizing method was applied. One of the earliest statistical studies was by Silbermann (759) 1856, who reported the height of 511 Frenchmen. After this no important work appeared until Godin (298-305) began studies which were published at irregular intervals between 1893 and 1914. Further contributions have been made by Binet and Vaschide (73) 1897, Dotcheff (216) 1901, Chaumet (166) 1906, Variot and Chaumet (838) 1906, and Camescasse (154) 1918. The growth of children has also been discussed by Dufestel (224) 1907, Ganjoux (288) 1900 and Devraigne (205) 1914.

(3) *England.* Forbes (258) 1836, in England, verified the general trend of the Quetelet Belgian curves. Danson (196) 1862, made an early study on growth in weight and height using as subjects 4800 prisoners in the Liverpool jail. This was, of course, a selected group, but was probably the only large body of individuals available at that early period. Steet (775) 1874-76, compared the development of boys between 13 and 20 years of age.

The first comprehensive program for the scientific study of physical growth was formulated and carried out under the initiative and direction of Roberts, Galton and the British Association for the Advancement of Science. Roberts (661) began the study of physical development in 1874-76, investigated the physique of factory children in 1876 (662), and made subsequent studies in anthropometry, publishing his excellent *Manual of Anthropometry* (663) in 1878. Galton (279) published an early study on weight and height of boys in 1873, and began his work for the Anthropometric Committee of the British Association for the Advancement of Science in 1875. Studies were published (280) in 1881, (281) in 1883, and (284) in 1884-85, a work on the heredity of physical qualities appearing in 1885 (285) and 1886 (286). Other English studies have been made by Stephenson (777) 1887, (778) 1888, Lane (458) 1892, Maclaren (495), 1895, Lee and Pearson (468),

1901. Kay (424) in 1904 contributed valuable statistics on Glasgow school children.

(4) *Germany.* One of the first German articles on the physical development of children was that by Brunniche (130) 1866. As early as 1877 Vierordt (844) published in Germany an important treatise amplified in 1881, on the growth of the body and its parts, a point of view which has been consistently emphasized and which characterizes the most modern books of Daffner (193) 1902, Ranke (644) 1894-1900, Weissenberg (865) 1911, and of Hoesch-Ernst and Meumann (241) 1906. Kotelmann's (449) first investigations bearing on hygiene were published in 1879; Hensen (365) 1881, discussed the subject from a physiological point of view; Daffner's work began to appear in 1884 (190 and 191) and was continued by a publication of 1892-93 (192). Two studies on the growth of boys by Landsberger (456 and 457) appeared in 1888. Weitzel's (867) measurements of girls were published 1890-91 at the same time as Wiener's (879) individual study.

Other important studies have been made by Carstädt (160) 1888; Hasse (353) 1891; Schmidt (724) 1892; Camerer (146) 1893; Weissenberg (859) 1895; Hergel (366) 1897; Monti (532) 1898; Salomon (686) 1898; Schmid-Monnard (722 and 723) 1900 and 1901; Rietz (657) 1903; Reuter (653) 1903; Ranke (645 and 646) 1905; Stratz (788-794) 1908, 1909, 1911, 1912, 1914 and 1915; Schwerz (736 and 737) 1911 and 1912; Wagner (853) 1911; Ascher (18) 1912; Peiper (582 and 583) 1911 and 1912; Cohn (174) 1912; Riedel (656) 1913; Münch (544) 1914; Skibinski (763) 1914; Matusiewicz (508) 1914; Guttmann (334) 1915; and Schlesinger (713 and 714) 1917.

An important collection of tables from various sources was published by Vierordt (846) in 1906. Bachauer and Lampert (23) 1919, proposed a comprehensive program for a system of measurements on children.

(5) *Russia.* In Russia much valuable anthropometric work has been done, but as previously stated, only a limited number of investigations have been accessible, and no doubt during the last few years a large number of these may have been destroyed. Many valuable studies are in the form of Doctor's dissertations which are filed in the archives of various libraries and have been referred to principally through the work of Sack and Wiazemsky, who seldom give the exact title, number of pages, date or place of publication.

Vassiliev (841) published an early study on girls, 1881. In 1882 Dudrewicz (223) made anthropometrical measurements of children in Warsaw; Diek (210) 1883, made a more comprehensive study and in 1886 Belaiew (47) studied the children of Simbirsk. Other studies are as follows: in 1887 Suligowski (796) pupils in Radom; in 1890 Sograf (765) in Jaroslav, Kostroma and Vladimir provinces; in 1890 Milailow (526) Moscow; in 1892 Grinevski (324) Odessa; in 1892 and 1893 Sack (681-684) Moscow; in 1894 Vinogradorsk-Lukersk (849) general study of high school pupils; in 1895 Matveyeva (509) St. Petersburg; in 1896 Tezyakoff (809) in Yelisavetgrad County; in 1900 Rostovtsev (674) in Dmitrovak; in 1902 Bondyrew (105); in 1903 Karnikki (421); in 1905 Pismennry (602) Serpukhor County. Gundobin's (331) book on the characteristics of childhood, was published in 1905, Wiazemsky's (878) Paris dissertation on physical growth of Russian children appeared in 1907, Berlinerblau's (57) study of an orphanage, Moscow, 1908, Gruzdeff's (327) 1912, and Gorokhoff's (310), 1916. Anutschin's (14) general study of the male population of Russia and Mereshoffsky's (518) on the development of children, appeared prior to Sack's dissertation, 1892, where they are cited without dates.

(6) *Italy.* In Italy an early investigation from the sociological point of view was made by Pagliani (573 and 574) 1875-76 and 1879. The Bertillon (59 and 60) system of criminal measurement was described in French in 1889 and in English in 1896. The chief pedagogical studies have been made by Santori (688) 1907, and Montessori (531) 1913.

(7) *China and Japan.* An anthropometric study of Chinese students was made by Merrins (519) 1910. With a view to developing norms for the Chinese race, the Medical Missionary Association has initiated anthropometric investigations, the first results of which were reported by Whyte (875-876) 1917 and 1918. Pyle (625) published in America, 1918, a comparison between American and Chinese children. In Japan three very important studies have been made by Miwa (529) 1893, of individuals from three to 80 years; Misawa (528) 1909, made a study of 869,014 children; and Hatta (358) recently made a report on 786 Japanese boys. A comparative study of Japanese and Chinese children appeared in 1903, by Wood (887). At the American University at Pekin, Cowdry is beginning work under the direction of the Smithsonian Institution at Washington.

(8) *Spain.* Little work has been done in Spain, but reference should be made to the work of Arthaud (17) in 1895.

(9) *Norway, Sweden and Denmark.* Studies of the growth of the Scandinavian people have been made in Norway by Faye (248) 1914, Schiötz (704-709) 1917, and Zeiner-Hendriksen (903 and 904) 1918 and 1920; in Sweden by Wietlind (880) 1878, Törnell (823) 1909, and by Sündell (797) 1917. In Denmark the years 1907-11 saw a number of investigations by Hansen (347), Rambusch (640) and Hertz (371).

(10) *Netherlands.* In the Netherlands a study of the height of males was made in 1910 by Bolk (104); a more general study of the male population in 1916 by Benders (49); and an investigation of the weight of children by Van der Loo (485), 1919.

(11) *Finland.* In Finland an important study by Oker-Blom (561) appeared in 1912.

(12) *America.* (a) School Children. The interest in pedagogical anthropometry which has had such an influence on school administration probably began in America with Bowditch's (109 and 110) reports to the Massachusetts Board of Health, 1875 and 1879, in which were analysed the statistics on thousands of school children to show the influence of nationality and social class. Equally fundamental for the establishment of the new concept of the growth process were reports on the physique of women (112) 1890, and on the growth of children studied by Galton's percentile grades (113) 1891. Later work was that of Peckham (580 and 581) 1881 and 1882, whose reports to the Wisconsin Board of Health included many valuable statistics on growth. In 1887 Stephenson (777) published a brief account of the rate of growth in children. Greenwood's Kansas City studies (317) 1890 to 1892, gave the height and weight of a large number of children. Boas' (82) Worcester study, 1892, discovered some important differences in the growth of young and older, and of tall and short children. Jackson (415) in 1892 published tables of the measurements of Easthampton students. Barnes's (35) California study, 1892-93, showed that Oakland children surpassed in physical development children from other localities studied up to this time. Moon (533-535) presented brief studies of Maryland boys, 1892 and 1896. Porter's (611-615) St. Louis studies appeared 1892 to 1894.

In 1893 and 1894 West (870-872) made some important observations of the growth of the head, body and face of Worcester, Mass.,

school children. Seaver (742) 1895-96, presented some new anthropometrical data. Boas' (84) conclusions about the advantage in growth held by first-born children resulting from an analysis of the Oakland and Toronto data were published in 1895 and subsequent findings (88) in 1897. Burk (136) published in 1898 a good summary and comparison of previous work on growth. Boas and Wissler's (100) elaborate collection and analysis of statistics on growth appeared in 1904. Gardiner and Hoagland (289) 1903, discussed the growth of California children. Robertson (669) further analysed the Oakland statistics in 1916. Holt's (397) comparative study appeared in 1918.

(b) College Students. In the standardization of anthropometric methods and instruments and in the securing of reliable data for the establishment of standards and norms, the physical training departments of colleges and universities have contributed substantial scientific data. The study of college students was begun at Marlborough College in 1874, by Fergus and Rodwell (251). In 1888 Hitchcock (380-388) started important studies at Amherst College. which were continued through 1893. Tuckermann (825) published some of the Amherst data in 1888. Seaver (741) 1889, issued a table of percentile values for fifty different measurements on Yale students ranging between 16 and 21 years of age. Sargent at Harvard has been working for years in an effort to determine the proportions of the typical man (690) 1887, scholars and athletes (693) 1908, and the typical woman (691) 1889. A series of charts (692) summing up these measurements appeared in 1893. At Wellesley College, Wood (888-892) 1890 to 1903, published tabulated data on the physical development of college women and Enebuske (235) 1894, gave measurements of normal school students of physical training. There followed investigations at Bryn Mawr by Hurd (408) 1891, and by Foster (260) 1898; at Oberlin by Hanna (345) 1893; at Haverford by Hall (341) 1895; at the Universtiy of Nebraska by Barr (36) 1903; at Ann Arbor by Bean (41) 1907-08; at Oxford by Schuster (730) 1911. Elson (233) 1910, presented some statistics on special students in an agricultural college.

B. PARTIAL AND TOTAL GROWTH

A number of special studies have been made on the growth of particular parts of the body, on the proportions of the body during

growth and on the correlations of different physical measurements during the years of growth. In the year 1854 this problem of proportions was discussed both by Carus (161) and by Zeising (905-908) whose work continued into 1859. In 1862 Welkner (868) investigated the growth of the head and Angerstein (9) 1865, made a general contribution to the theory of proportions.

Quetelet's (629-632) studies, 1846-1854, which have previously been classed under the head of racial differences, were continued by some general discussions (633 and 634) in 1870. There followed studies by Dally (194) 1872, Kotelmann (449) 1879, Lucae (488) 1882, Thoma (812) 1882, Oppenheimer (564) 1888, Hansen, (346) 1891-92, Anthony (13) 1894, Tichanoff (820) 1894, Richards and Little (654) 1896, Ripley (659) 1896, on the forms of the head and Boas (87) 1896, with a discussion of Ripley's article, Roshdestwensky (673) 1897, Binet (69) 1901, on the growth of head and face, Teumin (808) 1902, Manouvrier (500) 1902, Pfitzner (595) 1903, Seggel (744 and 745) 1903, Wissler (883) 1903, Röse (672) 1905, Laumonier (466) 1909, Weissenberg (862 and 864) 1909 and 1910.

Among recent correlation studies are those by Alfeyeff (4) 1912, weight, height and chest measurements; Weisse (858) 1912, chest and abdominal measurements in relation to build; Downes (217) 1913-14, trunk measurements and stature; Lêvy, Magnan and Sellet (473) 1914, height and chest circumference; Walker (854) 1915, relation of weight to body length. Baldwin has presented in this *Study*, pages 117 to 148 numerous coefficients of correlation for physical measurements.

C. PERIODS OF GROWTH

Attempts have been made from time to time by various investigators to divide the growth process into periods or stages of development. Bryan (132) 1900, has given a review of such attempts and discussed the significance of such stages in growth. It is, however, very undesirable to try to divide the years of average growth in any such manner as was attempted by Vierordt, Liharzik, Zeising or Key, since growth is a continuous process with no abrupt step from stage to stage. Individual and sex differences and variations in growth due to physiological maturity, heredity and racial, social and individual type still further complicate the problem. It is still an open question whether it will be possible with adequate data

consisting of repeated measurements on a sufficient number of children for a considerable period of time to outline such periods in the growth of normal children.

7. Conditions Affecting Growth

A. CLIMATE AND SEASON.

Few definite scientific data are available concerning the influence of season and climate on physical growth, since the problem is a difficult one to solve without consecutive measurements on the same group of individuals. In 1875 Baxter (39) made an important study for the Provost General's Bureau, which showed that the size of adult Americans is different in different parts of the United States, this being attributed to the influence of climate on growth. The best work was started by Malling-Hansen (497) 1883, in which an exhaustive and careful treatment was made of periodicity in the weight of children who were measured daily. This article was followed by an address before an international medical congress at Copenhagen on the effects of change of diet on growth at different times of the year (498). In 1886 Malling-Hansen (499) published a somewhat fantastic treatise on variations in weight coincident with variations in the heat of the sun's rays, in which it was found that for weight the greatest growth was from August to the middle of September and the least during May, June and July, while for height the reverse was true. Voit (850) 1886 and Zacharias (901) 1889, discussed these results. Vahl (832) 1884, discovered, for children in a girls' school weighed semi-annually from 1874 to 1883, that there was a greater increase in weight in summer than in winter. Schmid-Monnard (719 and 720) 1895 and 1896, found Malling-Hansen's "periods" characteristic of German children. Gray (315) 1910, published his *Diurnal Variations in Weight* as a Bachelor's thesis; Makower (496) 1914, substantiated the Schmid-Monnard thesis by a study of 400 Jewish children; Órum (568) found seasonal variations in weight, 1914; Lentz (470) 1917, showed that for German children April, May and September were best for general health, while November and December were worst.

Hall (340) quotes Zak (Sack?) as finding height decreasing during the day and weight increasing, and Vierordt (845) found weekly or half weekly periods repeating themselves. Pittard (603)

1906, also discussed the influence of geographical *milieu* upon height. Porter's (618) investigation in 1920 shows that for American children the increase in weight is greater from June to December than from December to June.

B. EFFECTS OF WAR

In Germany, where the food shortage was especially acute, school physicians and health authorities have undertaken numerous investigations to discover whether the growth and nutrition of children were suffering. Some of these reports are documents of a political and controversial nature, but a certain number are deserving of scientific attention. The studies made in 1916 by Häberlin (336), Schlesinger (712), Lommel (483 and 484), Gohde (306) and Thiele (811) showed that no harmful effects of the food shortage had yet become apparent. Herzog (372) 1916, and Engelhorn (236) in the same year, even claimed war children to be in somewhat better condition, probably because of the war time emphasis on hygiene and the more sensible diet. These results were confirmed for 1917 by Oschmann (570) and Lübsen (487) and for 1919 by Siegmund-Schultze (755) and Poetter (607). Other investigators showed, however, that especially during the later years of the war, bad conditions were beginning to have their effect. Kettner (429) found that as early as 1915 a decrease in the growth of children was apparent and Engelhorn (237) 1916-17, discovered that city children were in somewhat poorer condition than during the second year of the war. Davidsohn (202) 1920, found a decrease in growth and Pfaundler as reported in an anonymous editorial (12) in 1919 showed that boys and girls grew less during the war and that the average decrease in gain was more conspicuous in children of professional classes.

Among French investigations a research made by Bleyer (78) for the American Red Cross Children's Bureau showed that the children of Vienne, a manufacturing town of France, were in good condition in 1919. Du Bois (222) 1919, published some data on the children of Liége. In England Howard (399) 1919, discussed war bread and the growth of children.

C. SOCIAL STATUS

Whether the good development of children from the favored classes is due to environmental influences including diet and medical

inspection or to superior heredity is a question that cannot be settled with the data at hand. The superiority in development is the common report of investigators. As early as 1829 Villermé (847 and 848) showed that good homes and good nutrition contribute materially to physical growth. Bowditch (110) 1879, showed that the "favored classes" with good nutrition are superior to general classes, especially in height. This view was also held by Roberts (663) 1878, by the Anthropometric Committee of England under the chairmanship of Galton (281) 1883, by the Danish Commission under Hertel (368 and 370) 1882, by Geissler and Uhlitzsch (291) 1888, and by Geissler (292) 1892, by Erismann (239 and 240) in Russia 1888, and by Key (430) in Sweden, 1885. Stanway (773) 1833, published the results of investigations into the comparative health and condition of factory and non-factory children of Manchester and Stockport. Malling-Hansen's (497) study of food values in Copenhagen gave in general negative results. Pagliani's (574) Italian study appeared in 1879. Landsberger's (457) study of boys appeared in 1888. Kozmowski's (448) intensive work on the weight and growth of children of the poorer classes of Warsaw is dated 1894. From 1899 to 1902 Pfitzner (592-594) published a series of "Social Anthropologische Studien." Niceforo (549) 1903, began a study of over 3,000 children in the schools of Lausanne, classified according to social status. Koch-Hesse (445) 1905, compiled much statistical material from various investigators. Allaria (5) 1912, investigated the growth of children of the poorer classes. Young (900) 1913, found the children of the rich to be better developed than children who attended public schools. Elderton (229) 1914, classified the measurements of over 63,000 Glasgow school children in four social groups. Dikanski's (211) 1914, arrangement of Hoesch-Ernst's material showed better physical development with rising social class. Brezézinski and Peltyn (123) measured children of factory workmen, 1914. Frankel and Dublin (263) 1916, analyzed the measurements of 10,000 children who received employment certificates in New York City during the previous year. Schlesinger (713 and 714) 1917, again proved the superior development of the children from well-to-do families. The measurements by Baldwin (27) 1914 and this *Study,* on children of the well-to-do class are on the whole extremely high.

D. CITY VS. COUNTRY LIFE

Although many studies of school children in and around certain cities would probably permit of comparisons of the physical development of city and country children, if the original data were at hand, there have been few studies undertaken directly for this purpose. The question of stature in the city and country population was discussed by Quetelet (626) in 1830. Galton (279) 1873-74, and Peiper (583) 1912, found country boys to be both taller and heavier than city boys. Baldwin (28) 1916, obtained results that were in agreement with this, inasmuch as it was found that country boys mature earlier than city boys. Pyle and Collings (624) 1918, found that there was a slight difference in favor of city children. Urick (831) 1918, presented statistics on city and country children in Iowa.

Doubtless the War Departments of various countries are in possession of much material on this point, but little has been published. The statistics of men drafted in the United States during the World War, which were analyzed by Davenport and Love (200), showed that 61.74% of urban men were accepted without defect, rural 66.74%, and that 33.49% of urban men were accepted with defect, rural 28.30%.

E. HYGIENE AND EXERCISE

A great deal of work on physical growth has been approached from the point of view of hygiene. Measurements of children have often been undertaken in order that school desks might be better adjusted to the physique of the children. Other studies, especially in Germany and Russia, have been made with the purpose of ascertaining the effect of school conditions on the physical development of children. A third group deals with the effect of exercise, physical training and college athletics. Other investigations are concerned with general health, diseases and physical defects.

Many of the references on physical hygiene are classified under other specific subjects, since the field is comprehensive and indefinite, but those of particular import limited to the influence of hygienic conditions are: Hutchinson's (409) 1846, and Pagliani's study (573) 1875, with particular reference to breathing capacity; Roberts' (662) factory report, 1876, and his memorandum on medical inspection (660); Kotelmann's (449), 1879, study on the influence of physical training; Bruun's (131) study in hygiene, 1887;

Geissler and Uhlitzsch's (291) study on fitting school desks, 1888; Kellogg's (426) strength studies, 1896; Porter's (616 and 617) 1896, measurements in schools; Taylor's discussion of the influence of exercise upon length of life (804) 1897; Burk's (138) *Influence of Exercise,* 1899; Bürgerstein's (135) *Schulhygiene,* 1902; Hastings' (357) *Health and Growth of School Children,* 1903; sketches of English school children by Thomas (815) 1905; Zahor's (902) Prague study, 1907; Tyler's general articles (828 aand 829) 1907 and 1908; Harrington's (348) *Health and Education,* 1910; Wright's (895) *Post-Adolescent Girls,* 1910; Baldwin's (25Q *Notes on School Observation,* 1911; Pyle's (622 and 623) manuals of 1913 and 1920; Terman's (807) *Hygiene of the School Child,* 1914; the comprehensive investigations by Tuxford and Glegg (827) 1911, including 583,640 English children between three and 14 years of age; Mumford's (543) 1912, Manchester grammar school investigation; with the additional English studies of Greenwood (316) 1915, and Tuxford (826) 1917; Penn (586) 1917; and Kerr (427-428) 1918 and 1919. In Germany appeared Meumann's (521), *Experimentelle Pädagogik,* 1911; Heller's (364) studies on Salzburg children, 1913-14; Steinhaus' (776) 1913; Spitzy's (771) *Die körperliche Erziehung des Kindes,* 1914; and Matthias' (507) 1916, work on the effect of physical exercise on Swiss athletes. Laurent's (467) investigation of physical education in France; and the important Russian studies cited by Sack, *i. e.* Leshaft (471) 1879-80, Nagorsky (548) 1881, Michailoff (523) 1887, Belyaieff (48) 1888, and Zhbankoff (910) 1889.

F. SPECIAL CONDITIONS

A number of isolated investigations deal with the relation between growth and other special conditions not previously listed in this resumé. Among these is an investigation of loss of weight and gain in height during sleep, by Curtiss (186) 1898. Burk (137) in 1899 discussed the influence of sex on growth. Cailli (142) 1903, noted the effect of country living. Boas (94) 1909, published an article on civilization and stature. The work of Davenport reported in his *Heredity in Relation to Eugenics* (198) 1911, and his *Inheritance of Stature* (199) 1917, continued a line of investigation begun by Galton. Carmon (159) 1912, published a discussion of rapid changes in weight. Boas (99) 1913, traced the effect of heredity

and environment on growth. Reports on growth and dentition were made by Bean (42) 1914, and Spier (769) 1918. Stiles and Wheeler (782) 1915, analyzed physical measurements of American children from homes of good and poor sanitary condition. Camescasse (155 and 156) 1918, reported the results of an experiment in which for the sake of economy bread was replaced by rice and vegetables, with good results. In 1919 Dick (206) published in England his book on the effect of defective housing on growth. Powys (621) 1902, and Harris (349) 1920, have noted the decrease in stature in later adult life. Retan (652) and Emerson (234) have been particularly interested in the relation between nutrition and physical development.

8. Special and Abnormal Phases of Growth

A. PATHOLOGICAL

A limited number of good scientific studies has been made on the relationship between growth and disease. In 1881 Bowditch (111) asserted that the "normal rate of growth would not only throw light on the diseases to which childhood is subject, but would also guide us in the application of therapeutic measures." One of the earliest treatises was by Regnier (650) 1860. Then came Auboyer's (20) work in 1881. Hertel (368) 1882, published the report of the Danish Commission including measurements of 17,595 boys and 11,646 girls. In 1885 appeared his *Overpressure in the High Schools of Denmark* (369), and in 1888 a comparison between the findings of the Danish and Swedish Commissions (370). Key's (430) important Stockholm study appeared in 1885 and the German edition in 1889; Michailoff's (523) Russian study, 1887; Springer's (772) 1890; Carlier's (158) 1892; Bézy's (66) 1894; Combe's (175) investigation in Lausanne, 1896; Warner's (856) comprehensive English study, 1897; Schmid-Monnard's (721) German study in 1897; Ranke's (646) German study, 1905; Camerer's (151) investigation of malnutrition, 1905; Gundobin's (331 and 332) Russian investigation, 1905 and 1907; Holmgren's (395) article on the influence of Basedow's disease on stature, 1909-10. Other important contributions are Camerer's (152) general account of growth in relation to disease, translated 1908; Baldwin's (25) *Notes on School Observation,* 1914; Chose's (169) 1914 work on rachitis and growth; Thiele's (810) 1915 on tuberculosis; Schiötz's (702 and

703) articles on growth and disease, 1915 and 1916; and Strong's (795) study of the effect of hookworm, 1916. Many general texts on children's diseases contain chapters on growth. Among those not previously mentioned is that by Feer (250) 1911. Kötz (450) 1918-19, discussed the phenomena of unequal growth of the two sides of the body, and Thoma (814) 1918, the conditions that interfere with the growth of the head.

B. MENTAL ABNORMALITY

From the standpoint of developing standards for the physical growth of normal boys and girls, valuable facts have been obtained through comparison with the growth of feeble-minded children. The first study dealing with the physical growth of idiots and imbeciles (mentally deficient children) was published by Roberts (663) in the manual on *Anthropometry,* in 1878. The investigation, which was probably made in 1871, included the height and weight of 829 children and adults between the ages of three and 15 years, from the asylums in England, without differentiating between the sexes. In 1877 Shuttleworth (752) published in America a very good paper on the growth and mentality of feebleminded children. Tarbell's (801 and 802) studies appeared in England, 1876-86 and 1888-89. Wylie (897 and 898) 1899 to 1903, made careful studies of 400 boys and girls from Minnesota and concluded that feebleminded children were subnormal in physical development, while Macdonald (490) 1897-98, also found children with abnormalities inferior in growth to children in general. Binet's (68-71) significant studies appeared in France in 1900 to 1910. A later book with Simon (72) was translated, 1914. Simon's (761 and 762) studies appeared 1899 and 1900; Vaney's (833 and 834) 1906-1909, and Martin's (504) in 1912. Norsworthy (553) 1906, could find no distinguishable differences between the physical development of feebleminded and normal children compared with the Boas and Bowditch standards. Guttmann (333) reported comparative measurements of normal and abnormal children in 1906. Goddard (297) 1912, has made the most valuable and painstaking study within this field, having recorded measurements on 10,000 children at the Vineland Training School in New Jersey and at eighteen other institutions in America. Doll (212) 1916, used the psychophysical measurements of right and left grip and lung capacity as diagnostic criteria of feeblemindedness, and Porteus (619) 1919-20,

has been making careful studies in cephalometry of the feeble-minded children at Vineland.

Among the special studies of physical development of the insane, should be mentioned Boyd's (114) 1861, studies on 2614 post-mortem examinations. Goodall (308 and 309) 1898 and 1901, compared the development of the insane and the abnormal. The physical development of delinquents has not received much attention, though several medical studies have been made. The best work in the anthropometric field is that by Marty (506) 1898, and by Tallant (800) 1912.

9. Physiological Age

A. Adolescent Growth

One of the most important present-day problems in physical growth from the standpoint of the educational, social, religious and psychological development of the child centers around the question of physiological age, with particular reference to the development during adolescence. In his early work, 1890, Key, (432) raised the problem of "Die Pubertätsentwicklung and das Verhältnis derselben zu den Krankheitsercheinungen der Schuljugend." In 1891 Key (433) made another contribution to the subject, as did Miwa (529) 1893. Morey-Errant (538) 1898, published a general discussion bearing primarily on puberty; Lincoln (477) 1896, published a practical paper with some good observations on sexual maturity; Moon (536) 1899, printed a short paper with a discussion of the question of growth and puberty, claiming that the latter had no effect on growth; Godin (298, 301, 302) in 1902, 1911 and 1912, published brief papers on the adolescent type, based on his 1903 study (299), with 36,000 measurements on the same one hundred subjects followed from 13 to 18 years of age. In 1902 and 1907 Wiazemsky (877 and 878) published important studies on modifications of the organism during the period of puberty. Kimpflin (436) 1914, reported measurements of 200 adolescents. Riebesell (655) 1916, proposed that weight as a function of time should be used as an index of physiological age.

B. Physiological Age and School Progress

The educational and sociological significance of the problem of physiological age has been championed by Bryan (132) 1900; Crampton (181-184) 1908; Weissenberg (865) 1911; Foster (261)

1910-11; Boas (98) 1912; Beik (46) 1913, and Baldwin (27 and 28) 1914 and 1916. Bean (42) 1914, reported on the relation between dentition and maturity, while Rotch (675 and 676) 910, initiated the problem of the graduations of carpal and epiphyseal development. The question of adolescence in its psychological, sociological and educational bearings, together with comparative data from various investigations on physical development, has been treated by Hall (340) in his *Adolescence,* 1904.

10. Physical Growth and Mental Development

A most significant trend of investigations on physical growth, from the writer's point of view, lies in the large number of studies dealing with the relationship between physical and mental development. Modern genetic, functional and behavioristic psychology all begin with the phenomena of physical growth. Warner's (855) 1890, very comprehensive but inaccurate study, served to initiate the problem in England. Other studies which contain material bearing on this problem, but usually not analyzed to show the exact relation between physical and mental development, have been made by Martiegka (502) 1898; Thorne (819) 1904; Berry (58) 1904; Quirsfeld (635-637) 1904-1907; Samosch (687) 1904; Eyerbibh and Löwenfeld (243) 1905; Popper (610) 1907; Arkle (15) 1908; Vaney (833-834) 1906 to 1909; and Albert and Arvizu (3) 1917. Burk (136) 1898, Oppenheim (563) 1898, Hall (340) 1904, Thorndike (817) 1901, Whipple (874) 1915, and Kirkpatrick (440) 1917, analyzed and summarized the general problem more or less extensively without original data.

A. ABSENCE OF CORRELATION

A number of investigations have shown no discernible relationship between mental and physical development. So, for example, Galton (287) 1891, in university tests found no correlation between literary ability and physical measurements. Gilbert (294 and 295) 1895 and 1897, and Cattell and Farrand (163) 1896, found no definite correlation between physical and mental tests. Radosavljevich (639) 1913, also could trace but little correlation between physical development and school brightness. The work of Pearson (577-579) 1901-02, and 1906, and of Lee, Lewenz and Pearson (469) 1903-04, showed very small and unreliable correlations between intelligence and physical characters.

B. NEGATIVE CORRELATIONS

Only one investigator definitely states a negative correlation. This is Sargent (693) 1908, who found that the "stipend scholarship men" at Harvard were among the shortest and lightest.

C. POSITIVE CORRELATIONS

The most significant pioneer study showing positive correlation was made by Porter (611-618) 1892-93, 1894 and 1896, who found that "precocious children are heavier and dull children are lighter than the mean children of the same age." Holmes (394) discussed this work in 1894 and Boas (86) in 1895. Positive findings have been confirmed or supplemented as follows: in Russia by Gratsianoff (313) 1889, and Sack (681) 1892,—in America by Hartwell (351) 1894-95; West (873) 1896; Macdonald (490-492) 1897-98 and 1910; Hastings (355) 1899; Christopher (171) 1900; Smedley (764) 1900; Beyer (65) 1900; Zirkle (911) 1902; Debusk (203) 1913; Mead (513) 1914; Grover (325) 1915; Donaldson (215) 1915; Stewart (780) 1916; Busk (140) 1917; Courtis (179) 1917; and Baldwin (25, 27 and 30) 1911, 1914 and 1920,—in Germany by Schmidt and Lessenich (725) 903; Graupner (314) 1904; Bayerthal (40) 1905-1910; Rietz (658) 1906; and Spielrein (768) 1916.

PART V

CHAPTER X

COMPARATIVE TABLES

These comparative tables are roughly grouped in three sections: I. Infants, II. Pre-School, III. School Children and Adults. Section I comprises children under one year, Section II those under six years, and Section III those over six years. In some cases where an investigator gives only a few measurements which should go under one section while the majority belong in another section, these age limits have not been strictly followed.

Some of the tables are continuations of tables in a preceding section. In such cases this fact is noted in the footnote. There are for Infants 59 tables, Pre-School Children 93 tables, School Children 491 tables, Total 643. Recorded number of cases 5,385,463.

The insertion of the symbol ** in a column of measurements indicates that the investigator gives some further data, usually on only a few cases and at such irregular age intervals as to make inclusion in these tables impracticable.

Within each of the three sections the tables are grouped according to the nationality of the subjects to facilitate comparisons of the measurements of similar racial groups. Within a nationality the arrangement of the names of the investigators, and consequently of the tables, is alphabetical. The columns and their descriptive footnotes are numbered consecutively, a complete number series being used for each of the following: Infants, Pre-School, Height of Males, Height of Females, Weight of Males and Weight of Females.

Each column also bears before the name of the investigator a number (sometimes joined with a letter) which will enable the reader to identify within each of the three sections the corresponding measurements resulting from the same investigation. For example, within the Pre-School Section, the figure 1 b recurring in Height of Males, Height of Females, Weight of Males and Weight of Females, is used always to designate measurements of a group of American born Bohemians studied by Boas. The figures 1 c, 1 d, etc. refer to other groups studied in the course of the same general investigation designated by the number 1. If Boas had made other investigations,

published in other articles, they would have received numbers 2, 3, 4, etc. This system for the identifications holds only within a section. A new series has been constructed for Infants, for Pre-School and for School and Adult. It is possible, however, to trace the same investigation throughout the different sections by referring to the footnotes.

Each column of measurements has a footnote giving the date of publication, the place where measurements were made, and such other information as could be obtained about the subjects, their social group, nutrition, race, school status, and number. In the footnote is also given the bibliography number of the article or book in which the investigation is published. The serial bibliography numbers correspond to the alphabetical arrangement of the contributions of a single investigator. References which deal primarily with work on infants under one year are designated by starred numbers in the bibliography.

I. INFANTS

HEIGHT OF MALES IN CENTIMETERS

	American				French		German	
Age in Weeks and Months	1. Baldwin[1]	3. Crum[2]	4. Freeman[3]	5. Holt[4]	9a. Variot and Fliniaux[5]	9b. Variot and Fliniaux[6]	10. Friedenthal[7]	11. Schmid-Monnard[8]
Birth	52.4			52.5				
1								
2								
3								
4								
1 mo.	53.8		54.9		53.0	52.8	54.8	50.6
5								
6								
7								
8								
2 mo.	57.9				57.3	56.6	58.4	54.1
9								
10								
11								
12								
13								
3 mo.	60.5		62.3		59.0	58.6	61.4	55.6
14								
15								
16								
17								
4 mo.	62.8				61.5	61.2	63.4	59.9
18								
19								
20								
21								
5 mo.	64.8				63.2	62.8	65.0	60.5
22								
23								
24								
25								
6 mo.	66.6	67.3	67.4	67.3	65.5	64.0	66.5	63.0
7 mo.	68.4	69.2			66.0	65.2	67.5	64.4
8 mo.	69.3	70.2			67.0	66.5	69.0	66.1
9 mo.	70.6	71.4	73.4		68.2	67.5	70.5	67.4
10 mo.	71.9	72.4			70.0	68.2	72.0	65.9
11 mo.	72.6	73.7			70.7	69.5	73.0	69.6
12 mo.	73.8	74.6	77.1	75.0	72.0	71.0	74.0	71.0

HEIGHT IN CENTIMETERS

	Females								Males and Females			
	American				French		German		Amer.	German		
Age in Weeks and Months	1. Baldwin[9]	3. Crum[10]	4. Freeman[11]	5. Holt[12]	9a Variot and Fliniaux[13]	9b Variot and Fliniaux[14]	10. Friedenthal[15]	11. Schmid-Monnard[16]	12. Fleischner[17]	19. Camerer[18]	21a. Russow[19]	21b. Russow[20]
Birth	53.9			52.0					53.3	52		
1												
2										52	51.0	49.0
3										55		
4										57		
1 mo.	53.3		54.8		53.0	52.7	53.0	50.1	56.6		55.0	53.5
5										56		
6										58		
7										60		
8										55		
2 mo.	56.2				55.6	56.5	56.0	53.8	60.5		58.0	56.5
9										59		
10										59		
11										56		
12										63		
13										61		
3 mo.	58.9		61.0		58.0	57.6	58.0	51.5	62.7	61	61.0	58.0
14										63		
15										62		
16										60		
17										63		
4 mo.	61.2				60.5	60.5	60.0	59.3	64.0		63.0	60.0
18										65		
19										65		
20										66		
21										66		
5 mo.	63.4				62.0	51.5	61.5	61.0	66.0		65.0	62.5
22										67		
23										65		
24										70		
25										66		
6 mo.	64.4	65.7	65.8	66.0	64.0	63.5	63.0	62.2	68.1	68	67.0	64.0
26												
27										70		
28												
29										68		
30										70		
7 mo.	67.1	67.3			65.0	64.5	64.5	64.0	68.6		68.0	65.0
31										69		

32										73		
33										71		
34										71		
8 mo.	68.6	68.6			66.0	66.0	66.5	64.9	69.6		68.5	65.0
35										67		
36												
37												
38												
39												
9 mo.	69.4	70.2	70.9		68.0	67.0	67.5	66.9	70.4		69.0	67.0
40										75		
41										75		
42										66		
43										70		
10 mo.	70.2	70.8			69.8	68.0	68.5	67.0	71.6		70.0	67.5
44										73		
45										78		
46										69		
47										72		
11 mo.	71.4	72.1			70.5	69.5	69.5	67.0	72.9		71.5	68.5
48										75		
49												
50												
51												
52												
12 mo.	72.0	73.3	75.5	73.7	71.5	71.0	70.5	68.1	73.9	76	73.0	69.0

WEIGHT OF MALES IN GRAMS

Age in Weeks and Months	American						English			Danish	French		German	
	1. Baldwin[21]	2a. Baldwin[22]	2b. Baldwin[23]	3. Crum[24]	4. Freeman[25]	5. Holt[26]	6a. Robertson[27]	6b. Robertson[28]	7. Robertson[29]	8. Örum[30]	9a. Variot and Fliniaux[31]	9b. Variot and Fliniaux[32]	10. Friedenthal[33]	11. Schmid-Monnard[34]
Birth	3996	3629	3408		3552	3430								
1		3827	3473											
2		3799	3558											
3														
4		3969	3924											
1 mo.	4154				4110					4150				
5							4394	3317	4169		3600	3582	4250	3451
6		4479	4088											
7														
8		4848	4584											
2 mo.	5149									4960				
9							5301	3997	4790		4330	4290	4950	4108
10		5075	4950											
11														
12		5358	5165											
13										5590				
3 mo.	5923				5824									
14		5642	5162				5840	4791	5493		5030	4820	5600	4840
15														

16		6038	5591							6175				
17														
4 mo.	6493						6350	5472	6196		5670	5760	6200	5670
18		6294	5936											
20		6407	6109							6720				
5 mo.	7096						7201	6407	6627		6180	6000	6750	5868
22		6691	5973											
24		6776	6793							7200				
6 mo.	7501	7059	6926	8165	7484	7260	7654	6861	7140		6800	6380	7250	6802
28		7172	6849							7630				
30		7626	7190											
7 mo.	8025			8675			8136	7569	7616		7100	6940	7750	7017
32		7541	6991							8040				
34		7853	7436											
8 mo.	8363			8959			8505	9327	7829		7620	7370	8200	7152
36		7966	7371							8400				
38		8250	7558											
9 mo.	8679			9242	8859		8817	7938	8020		8220	7500	8600	7579
40		8477	7669							8750				
42		8760	7660											
10 mo.	8949			9469			9242	8448	8496		8600	8000	8950	8312
44		8732	8051											
46		8788	8343											
11 mo.	9114			9696			9441	9129	8600		8800	8450	9200	8412
48		8817	8219											
50		9270	8386											
12 mo.	9399	9299	8423	9922	9906	9540	9355	9497	8909		8950	8810	9450	8588
54		9214	8771											
56		9440	9001											
58		10121												

WEIGHT OF FEMALES IN GRAMS

Age in Weeks and Months	American						English			Danish	French		German	
	1. Baldwin[35]	2a. Baldwin[36]	2b. Baldwin[37]	3. Crum[38]	4. Freeman[39]	5. Holt[40]	6a. Robertson[41]	6b. Robertson[42]	7. Robertson[43]	8. Örum[44]	9a. Variot and Fliniaux[45]	9b. Variot and Fliniaux[46]	10. Friedenthal[47]	11. Schmid-Monnard[48]
Birth	4252	3714	3340		3470	3260								
1		3317	3439											
2		3770	3496											
3														
4		4082	3892							3790				
1 mo.	3978				3924		4338	3402	4055		3580	3560	3850	3219
5														
6		4111	4159											
7														
8		4451	4590							4480				
2 mo.	4628						4763	3884	4522		4320	4160	4550	4002
9														
10		4763	4794											
11														
12		4904	4964											
13										5070				
3 mo.	5391				5611		5330	4423	5103		4960	4600	5200	4792
14		5245	5395											
16		5471	5299							5600				

17														
4 mo.	6041						5925	5075	5729		5360	5350	5750	5409
18		5755	5681											
19														
20		5982	5778							6120				
5 mo.	6579						6350	5216	6169		6140	5830	6300	5866
22		6265	6265											
24		6265	6124							6450				
6 mo.	6996	6520	6447	7598	7244	7030	7173	5613	6672		6720	6300	6800	6426
28		6747	6362							6850				
30		7059	6736											
7 mo.	7543			7881			7456	6010	7162		7050	6800	7350	6855
32		7258	7133							7240				
34		7172	7022											
8 mo.	7968			8278			7654	6776	7326		7580	7200	7800	6936
36		7484	7351							7625				
38		7683	7450											
9 mo.	8191			8675	8528		8505	7343	7525		8000	7450	8200	7396
40		7938	7717							7960				
42		8023	7552											
10 mo.	8339			8845			8930	7144	7747		8525	7945	8450	7527
44	8335	8083												
46		8335	7978											
11 mo.	8606			9129			9497	7513	8165		8750	8400	8700	7588
48		8647	8054											
50		8788	8304											
51														
12 mo.	8768	8902	8474	9412	9448	9310	9781	8165	8151		8900	8780	8900	7756
54		8930	8341											
56		9015	8431											
58			8375											

WEIGHT OF MALES AND FEMALES IN GRAMS

	American			French			German				
Age in Weeks and Months	12. Fleischner[49]	13. Griffith[50]	14. Holt[51]	16. Bouchaud[52]	17. Broudic[53]	18. Newman[54]	19. Camerer[55]	20. Fleischmann[56]	10. Friedenthal[57]	21a. Russow[58]	21b. Russow[59]
Birth	3266	3450	3310		3280		3433	3500	3500		
1		3360					3408				
2		3490			3350		3567			3564	3525
3		3670					3781				
4		3900			3810		4008		4500		
1 mo.	4355		3740	4000		3487		4550		4333	3914
5		4080					4199				
6		4260			4100		4422				
7		4460					4576				
8		4650			4370		4907		5400		
2 mo.	5080		4790	4700		4026		5500		4848	4569
9		4900					4958				
10		5050			4600		5227				
11		5220					5365				
12		5400					5600		6130		
13											
3 mo.	5942	5580	5620	5350	5080	4564	5693	6350		5701	5310
14		5760					5846				
15		5940					6033				
16		6080					6294		6800		
17		6240			5650		6434				
4 mo.	6623		6240	5850		5103		7000		6105	5871
18		6360					6516				
19		6490					6569				
20		6670					6824		7400		
21		6760					6962				
5 mo.	7167		6710	6500		5783		7550		6640	6042
22		6890			6250		7070				
23		6990					7251				
24		7140					7289		7900		
25		7210					7485				
26											
6 mo.	7938	7350	7120	7000	6710	6464	7505	7970		7072	6317
27		7440					7698				
28		7580					7774		8300		
29		7670					7946				
30		7770			7080		7911				
7 mo.	8029		7460	7450		6917		8330		7565	6680
31		7870					8061				

32		8000					8175		8650		
33		8070					8189				
34		8190			7400		8400				
8 mo.	8119		7670	7840		7229		8630		8102	7745
35		8300					8483				
36		8390					8655		8980		
37		8440					8746				
38		8480					8641				
39											
9 mo.	8255	8530	7850	8200	7740	7598	8674	8930		8401	7916
40		8570					8855		9280		
41		8710					8979				
42		8800					9146				
43		8890			8110		9028				
10 mo.	8845		8100	8500		7995		9200		8930	8000
44		8960					9232		9550		
45		9070			8280		9330				
46		9160					9307				
47		9230			8350		9398				
11 mo.	8981		8510	8750		8363		9450		9287	8180
48		9320					9589		9800		
49		9410			8500		9708				
50		9530					9628				
51		9640			8650		9816				
12 mo.	9480	9750	9050	8950	8770	8732	10141	9600	10000	9930	8480

I. INFANTS

1. 1920, Iowa, M 4682, see page 53. Continued in Section II as Column 82, height of males.
2. Bib. 185, about 1915, M 1644. Continued in Section II as Column 83, height of males.
3. 1920, New York, computed from data of private cases furnished by Dr. Freeman, M 194. Continued in Section II as Column 9, height of males.
4. Bib. 396, 1920.
5. Bib. 840, 1914, breast-fed, M 300.
6. Bib. 840, 1914, artificially-fed, M 492.
7. Bib. 274, 1914.
8. Bib. 718, 1892, Frankfurt a. M., breast-fed, M 823.
9. 1920, Iowa, F 4392, see page 53. Continued in Section II as Column 85, height of females.
10. Bib. 185, about 1915, F 1301. Continued in Section II as Column 86, height of females.
11. 1920, New York, computed from data of private cases furnished by Dr. Freeman, F 140. Continued in Section II as Column 37, height of females.
12. Bib 396, 1920.
13. Bib. 840, 1914, breast-fed, F 336.
14. Bib. 840, 1914, artifically-fed, F 384.
15. Bib. 274, 1914.
16. Bib. 718, 1892, Frankfurt a. M., breast-fed, F 736.
17. Bib. 255, 1906, well nourished infants. Compiled from his table of increments.
18. Bib. 148, 1901, breast-fed, M and F 119.
19. Bib. 680, 1881, breast-fed, M and F 92.
20. Bib. 680, 1881, breast- and artificially-fed, M and F 92.
21. 1920, Iowa, M 4682, see page 53. Continued in Section II as Column 88, weight of males.
22. 1920, Baltimore, white, consecutive measurements on children under medical and dietary supervision. M 100. See page 39.
23. 1920, Baltimore, colored, consecutive measurements on children under medical and dietary supervision. M 100. See page 43.
24. Bib. 185, about 1915, M 1644. Continued in Section II as Column 89, weight of males.
25. 1920, Computed from data of private cases furnished by Dr. Freeman, M 616. Continued in Section III as Column 53, weight of males.
26. Bib. 396, 1920.
27. Bib. 666, 1915, breast-fed. M 244.
28. Bib. 666, 1915, bottle-fed, M 88.
29. Bib. 669, 1916, M 1137.
30. Bib. 568, 1914.
31. Bib. 840, 1914, breast-fed, M 300.
32. Bib. 840, 1914, artificially-fed, M 492.
33. Bib. 274, 1914.
34. Bib. 718, 1892, Frankfurt a. M., breast-fed, M 823.
35. 1920, Iowa, F 4392, see page 53. Continued in Section II as Column 91, weight of females.
36. 1920, Baltimore, white, consecutive measurements on children under medical and dietary supervision. F 100. See page 37.
37. 1920, Baltimore, colored, consecutive measurements on children under medical and dietary supervision. F 100. See page 41.
38. Bib. 185, about 1915, F 1301. Continued in Section II, Column 92, weight of females.

39. 1920, New York, computed from data of private cases furnished by Dr. Freeman, F 463. Continued in Section II as Column 67, weight of females.
40. Bib. 396, 1920.
41. Bib. 666, 1915, breast-fed, F 168.
42. Bib. 666, 1915, bottle-fed, F 99.
43. Bib. 669, 1916, F 992.
44. Bib. 568, 1914.
45. Bib. 840, 1914, breast-fed, F 336.
46. Bib. 840, 1914, artificially-fed, F 384.
47. Bib. 274, 1914.
48. Bib. 718, 1892, Frankfurt a. M., breast-fed, F 736.
49. Bib. 255, 1906, computed from his table of increments.
50. Bib. 323, 1899, figures estimated from a chart.
51. Bib. 396, 1916, figures estimated from a chart.
52. Bib. 106, 1864.
53. Bib. 126, 1919, breast and artificially fed, M and F 300.
54. Bib. 669, copied from Robertson who says this English standard was derived from French infants.
55. Bib. 148, 1901, breast-fed, M and F 119.
56. Bib. 254, 1877.
57. Bib. 274, 1914.
58. Bib. 680, 1881, breast-fed, M and F 92.
59. Bib. 680, 1881, breast and artificially fed, M and F 92.

II. PRE-SCHOOL

HEIGHT OF MALES IN CENTIMETERS

	American									
Age in Years	1b. Boas[1]	1c. Boas[2]	1d. Boas[3]	1e. Boas[4]	1f. Boas[5]	1g. Boas[6]	1h. Boas[7]	1i. Boas[8]	2. Freeman[9]	3. Hrdlička[10]
Birth										
½									67.4	
1									77.1	
1½									82.7	
2									87.8	
2½									90.9	
3									98.0	78.4
3½									101.4	
4	99.4	98.0	99.0	101.2	97.4	96.3	98.0	96.5	103.9	
4½										
5	105.7	104.6	106.4	104.2	102.7	101.8	101.0	103.7	108.6	104.4
5½										
6	110.7	109.6	107.8	108.7	108.9	107.3	110.6	109.5	114.4	110.1

HEIGHT OF MALES IN CENTIMETERS

	Amer.	English					Bel.	Fren.	German			Russ.	Ital.	Japan.
Age in Years	4. Peckham[11]	5. Boyd[12]	6. Roberts[13]	7a. Tuxford & Glegg[14]	7b. Tuxford & Glegg[15]	7c. Tuxford & Glegg[16]	9. Quetelet[17]	10. Variot & Chaumet[18]	12. Daffner[19]	13. Ranke[20]	14. Schmid-Monnard[21]	15. Weissenberg[22]	16. Pagliani[23]	17. Misawa[24]
Birth			49.6				50.0		51.9	49.9	52.0	50.8		49.0
½														
1			68.6				69.9		73.8	62.6	70.2			73.5
1½		72.4						74.2						
2	75.0		85.6				79.0		85.2	77.1	81.7	80.6		79.5
2½								82.7						
3	85.9		93.5	92.4	93.1	91.3	86.4		91.7	87.5	86.5	87.2	86.1	85.4
3½		80.3						89.1						
4	94.1		97.7	98.2	98.5	97.7	92.7		96.5	92.8	95.6	94.3	92.0	92.0
4½								96.8						
5			104.2	103.0	103.2	102.7	98.8		102.8	99.6	99.7	100.7	97.0	97.5
5½		95.3						103.3						
6			111.8	108.0	108.6	107.5	104.7		105.8	105.9		108.3	103.4	102.8

HEIGHT OF FEMALES IN CENTIMETERS

	American									
Age in Years	1a. Boas[25]	1b. Boas[26]	1c. Boas[27]	1d. Boas[28]	1e. Boas[29]	1f. Boas[30]	1g. Boas[31]	1h. Boas[32]	1i. Boas[33]	1j. Boas[34]
Birth										
½										
1½										
2										
2½										
3							96.5			
3½										
4	96.0	95.3	99.5	93.0	98.3	98.1	96.7	95.0	99.5	96.5
4½										
5	110.0	105.5	103.9	102.6	103.9	101.1	100.6	104.2	102.7	100.9
5½										
6	118.3	109.6	111.9	108.6	110.3	107.9	107.4	112.0	106.5	108.3

HEIGHT OF FEMALES IN CENTIMETERS

	American					English					Bel.	Fr.
Age in Years	1k. Boas[35]	1l Boas[36]	2. Freeman[37]	3. Hrdlička[38]	4. Peckham[39]	5. Boyd[40]	6. Roberts[41]	7a. Tuxford & Glegg[42]	7b. Tuxford & Glegg[43]	7c. Tuxford & Glegg[44]	9. Quetelet[45]	10. Variot & Chaumet[46]
Birth						44.5	49.1				49.3	
½			65.8									
1			75.5				63.1				69.1	
1½			82.6			70.4						73.6
2			86.6		75.4		82.1				78.0	
2½			92.9									81.8
3		88.5	93.9	84.0	83.7		91.6	91.6	91.9	90.9	85.3	
3½			98.2			80.3						88.4
4	96.5	76.5	104.9	90.6	92.2		96.9	98.1	99.2	96.7	91.4	
4½												95.8
5	100.1	101.3	105.3	98.5			103.7	102.6	103.1	102.0	97.3	
5½						94.0						101.9
6	108.9	107.2	117.1	109.0			108.3	107.6	108.0	107.2	103.1	

HEIGHT OF FEMALES IN CENTIMETERS

	German			Russian	Italian	Japanese
Age in Years	12. Daffner[47]	13. Ranke[48]	14. Schmid-Monnard[49]	15. Weissenberg [50]	16. Pagliani[51]	17. Misawa[52]
Birth	51.9	48.6	51.7	50.0		48.8
½						
1	77.1	61.8	70.5			72.9
1½						
2	83.3	75.6	80.0	78.5		79.0
2½						
3	89.8	85.2	86.5	87.8	84.6	84.9
3½						
4	95.8	92.0	95.6	92.3	91.4	91.0
4½						
5	100.2	97.0	99.7	99.8	96.5	96.5
5½						
6	103.8	107.3		106.6	102.1	102.4

WEIGHT OF MALES IN KILOGRAMS

	American		English					Bel.	Fren.	German	
Age in Years	2. Freeman[53]	4. Peckham[54]	5. Boyd[55]	6. Roberts[56]	7a. Tuxford & Glegg[57]	7b. Tuxford & Glegg[58]	7c. Tuxford & Glegg[59]	9. Quetelet[60]	10. Variot & Chaumet[61]	11. Camerer[62]	14. Schmid-Monnard[63]
Birth	3.6		2.3	3.2				3.1			3.4
½	7.5										
1	9.9							9.9		10.1	8.6
1½	12.4		6.5						9.5		
2	13.1	11.1		14.7				11.0		13.2	11.1
2½	15.2								11.7		
3	16.9	13.8		15.4	14.9	14.9	14.7	12.5		15.4	13.2
3½	17.2		9.1						13.0		
4	18.6	15.9		16.9	16.3	16.4	16.1	14.0		16.8	14.7
4½									14.3		
5	20.6			18.1	17.5	17.7	17.3	15.9		19.3	16.1
5½			11.6						15.9		
6	21.7			20.1	19.3	19.4	19.3	17.8		21.1	

WEIGHT OF MALES IN KILOGRAMS

	Italian	Japanese	
Age in Years	16. Pagliani[64]	17. Misawa[65]	18. Miwa[66]
Birth		3.0	
½			
1		9.0	
1½			
2		10.8	
2½			
3	12.4	12.4	14.1
3½			
4	13.5	13.7	15.0
4½			
5	15.2	15.2	16.4
5½			
6	16.7	16.5	17.2

WEIGHT OF FEMALES IN KILOGRAMS

	American		English					Danish	Belg.	French	German		Italian	Japanese	
Age in Years	2. Freeman[67]	4. Peckham[68]	5. Boyd[69]	6. Roberts[70]	7a. Tuxford and Glegg[71]	7b. Tuxford and Glegg[72]	7c. Tuxford and Glegg[73]	8. Vahl[74]	9. Quetelet[75]	10. Variot and Chaumet[76]	11. Camerer[77]	14. Schmid-Monnard[78]	16. Pagliani[79]	17. Misawa[80]	18. Miwa[81]
Birth	3.5		1.9	3.1					3.0			3.3		2.9	
½	7.2														
1	9.4								8.6		10.1	8.6		8.5	
1½	11.6		6.0							9.3					
2	13.3	10.5							11.0		12.0	11.0		9.9	
2½	14.4									11.4					
3	16.3	13.3		14.5	14.4	14.5	14.3	14.7	12.4		14.0	12.6	11.2	11.5	13.4
3½	17.0		8.4							12.5					
4	18.5	15.1		16.1	15.8	15.9	15.7	16.2	13.9		15.7	14.3	13.1	12.9	14.8
4½										13.9					
5	19.5			18.0	17.1	17.2	16.9	17.9	15.3		17.5	15.6	15.0	14.5	15.6
5½			11.1							15.2					
6	21.4			19.2	18.6	18.7	18.4	18.9	16.7		19.0		16.4	16.0	16.8

HEIGHT OF PRE-SCHOOL CHILDREN IN CENTIMETERS

	Males			Females		
	American		German	American		German
Age in Months	19. Baldwin[82]	20. Crum[83]	21. Schmid-Monnard[84]	19. Baldwin[85]	20. Crum[86]	21. Schmid-Monnard[87]
13	74.7	75.9	70.7	73.2	74.6	71.8
14	76.0	76.8	72.2	74.2	74.9	70.9
15	76.6	78.1	73.0	75.2	76.5	70.5
16	77.7	79.1	74.1	76.2	77.5	72.5
17	79.1	79.7	76.0	77.2	78.1	73.8
18	79.4	80.6	74.6	78.1	79.1	74.1
19	80.4	81.9	76.1	79.3	80.0	73.8
20	82.1	82.9	77.5	80.8	81.3	74.6
21	82.9	83.5	75.7	81.3	81.9	75.2
22	83.7	84.5	78.2	82.4	82.9	77.7
23	84.5	85.4	78.1	82.9	83.5	77.0
24	84.9	85.7	78.8	83.5	84.8	79.5
25	85.8	86.4	80.0	83.9	85.7	79.2
26	86.7	86.7	81.6	84.7	86.0	80.4
27	87.0	88.3	80.0	85.9	86.0	80.0
28	87.8	89.2	82.0	86.5	87.9	80.0
29	88.3	89.9	82.5	86.8	88.3	83.5
30	88.6	89.9	83.7	87.9	88.6	83.4
31	89.4	90.2		88.6	89.2	
32	91.2	91.4		89.7	89.9	
33	91.3	91.8		90.1	90.5	
34	91.9	92.7		90.5	92.7	
35	92.5	93.3		91.3	92.7	
36	92.8	94.3		91.5	93.3	
37	93.7	94.9		92.4	93.3	
38	94.1	95.3		92.9	94.0	
39	94.8	96.2		94.0	94.6	
40	95.5	97.8		94.2	95.3	
41	95.8	98.1		94.6	95.9	
42	96.3	98.1		95.3	96.5	
43	97.6	98.4		96.2	97.2	
44	98.0	98.7		96.4	97.8	
45	98.8	99.1		97.3	97.8	
46	99.3	99.1		97.8	98.4	
47	99.3	99.7		98.3	98.7	
48	100.1	100.3		98.4	99.1	
49	99.9			99.9		
50	100.8			99.9		

51	101.6			100.5		
52	101.7			100.9		
53	102.1			101.1		
54	102.7			101.7		
55	103.2			102.1		
56	104.0			103.0		
57	105.0			103.8		
58	105.3			104.3		
59	105.5			105.1		
60	105.8			105.1		
61	106.4			105.3		
62	106.7			106.0		
63	107.7			105.5		
64	107.0			106.4		
65	107.2			107.2		
66	108.8			107.4		
67	109.6			107.0		
68	109.8			108.3		
69	110.4			108.7		
70	111.5			110.8		
71	112.1			110.3		
72	112.0			109.7		

WEIGHT OF PRE-SCHOOL CHILDREN IN KILOGRAMS

	Males			Females		
	American		German	American		German
Age in Months	19. Baldwin[88]	20. Crum[89]	21. Schmid-Monnard[90]	19. Baldwin[91]	20. Crum[92]	21. Schmid-Monnard[93]
13	9.5	10.4	8.48	9.2	9.5	8.28
14	9.8	10.4	8.90	9.2	9.8	8.35
15	10.0	10.7	8.83	9.3	9.9	8.20
16	10.1	10.9	9.41	9.5	10.3	8.81
17	10.4	11.1	9.81	9.7	10.4	9.16
18	10.6	11.2	9.65	9.9	10.6	9.22
19	10.8	11.6	9.82	10.2	10.8	9.25
20	11.1	11.7	9.97	10.6	10.9	9.08
21	11.3	11.7	9.91	10.6	11.2	9.26
22	11.5	12.2	10.33	10.8	11.5	9.89
23	11.7	12.2	10.23	11.1	11.6	9.70
24	11.7	12.3	10.55	11.1	12.0	10.11
25	11.9	12.6	10.54	11.4	12.2	10.06
26	12.2	12.8	11.13	11.4	12.4	10.34

27	12.3	13.2	11.10	11.7	12.4	10.51
28	12.3	13.2	11.00	11.9	12.6	10.15
29	12.6	13.3	11.15	12.0	12.6	11.10
30	12.8	13.4	11.41	12.2	12.8	10.83
31	12.9	13.8		12.4	13.0	
32	13.3	13.9		12.6	13.2	
33	13.5	13.9		12.7	13.2	
34	13.4	14.1		12.8	13.7	
35	13.7	14.5		13.0	13.7	
36	13.7	14.6		13.1	13.8	
37	14.0	14.6		13.3	13.9	
38	14.0	14.7		13.5	14.1	
39	14.2	15.0		13.7	14.3	
40	14.3	15.2		13.6	14.5	
41	14.4	15.3		13.8	14.6	
42	14.6	15.3		14.1	14.7	
43	14.9	15.3		14.2	14.9	
44	15.0	15.5		14.2	15.0	
45	15.0	15.6		14.3	15.1	
46	15.4	15.8		14.5	15.2	
47	15.4	16.2		14.7	15.2	
48	15.5	16.3		14.6	15.3	
49	15.9			15.0		
50	15.6			15.1		
51	15.8			15.3		
52	15.9			15.3		
53	16.1			15.4		
54	16.3			15.4		
55	16.2			15.6		
56	16.3			15.8		
57	16.7			16.1		
58	16.9			16.0		
59	17.0			16.5		
60	16.9			16.4		
61	17.2			16.5		
62	17.3			16.9		
63	17.5			16.7		
64	17.3			16.6		
65	17.5			17.1		
66	17.7			17.1		
67	18.2			17.5		
68	18.3			17.5		
69	18.6			18.2		
70	18.9			18.3		
71	18.6			17.9		
72	18.6			18.1		

II. PRE-SCHOOL

1. Bib. 95, 1911, American born Bohemian, M 82. Continued in Section III as Column 12, height of males.
2. Bib. 95, 1911, American born Hungarian and Slovak, M 37. Continued in Section III as Column 13, height of males.
3. Bib. 95, 1911, American born Polish, M 19. Continued in Section III as Column 14, height of males.
4. Bib. 95, 1911, American born Hebrew, M 99. Continued in Section III as Column 15, height of males.
5. Bib. 95, 1911, American born Sicilian, M 111. Continued in Section III as Column 16, height of males.
6. Bib. 95, 1911, American born Neopolitan, M 137. Continued in Section III as Column 17, height of males.
7. Bib. 95, 1911, foreign born Bohemian, M 8. Continued in Section III as Column 20, height of males.
8. Bib. 95, 1911, foreign born Neopolitan, M 22. Continued in Section III as Column 25, height of males.
9. Computed from data of private cases furnished by Dr. Freeman, M 184.
10. Bib. 403, 1899, New York, negro asylum children. Continued in Section III as Column 46, height of males.
11. Bib. 581, 1882, Milwaukee, school children, M and F 228.
12. Bib. 114, 1861, London.
13. Bib. 663, 1878, all classes. Continued in Section III as Column 73, height of males.
14. Bib. 827, 1911, all England, M 119,427. Continued in Section III as Column 84, height of males.
15. Bib. 827, 1911, county education areas, M 60,550. Continued in Section II as Column 85, height of males.
16. Bib. 827, 1911, urban education areas, M 58,877. Continued in Section III as Column 86, height of males.
17. Bib. 628, 1836, M 10 at each age. Continued in Section III as Column 95, height of males.
18. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 98, height of males.
19. Bib. 190, 1884, M 426.
20. Bib. 645, 1905. Continued in Section III as Column 115, height of males.
21. Bib. 723, 1901, Halle, M 345. Continued in Section III as Column 126, height of males.
22. Bib. 865, 1911, M 239. Continued in Section III as Column 151, height of males.
23. Bib. 573 and 574, 1875-79, Turin. Continued in Section III as Column 153, height of males.
24. Bib. 528, 1909. Continued in Section III as Column 156, height of males.
25. Bib. 95, 1911, American born Scotch, F 5. Continued in Section III as Column 10, height of females.
26. Bib. 95, 1911, American born Bohemian, F 85. Continued in Section III as Column 11, height of females.
27. Bib. 95, 1911, American born Hungarian and Slovak, F 30. Continued in Section III as Column 12, height of females.
28. Bib. 95, 1911, American born Polish, F 29. Continued in Section III as Column 13, height of females.
29. Bib. 95, American born Hebrew, F 102. Continued in Section III as Column 14, height of females.
30. Bib. 95, 1911, American born Sicilian, F 94. Continued in Section III as Column 15, height of females.

31. Bib. 95, 1911, American born Neopolitan, F 104. Continued in Section III as Column 16, height of females.
32. Bib. 95, 1911, foreign born Bohemian, F 12. Continued in Section III as Column 19, height of females.
33. Bib. 95, 1911, foreign born Hungarian and Slovak, F 7. Continued in Section III as Column 20, height of females.
34. Bib. 95, 1911, foreign born Hebrew, F 23. Continued in Section III as Column 22, height of females.
35. Bib. 95, 1911, foreign born Sicilian, F 30. Continued in Section III as Column 23, height of females.
36. Bib. 95, 1911, foreign born Neopolitan, F 23. Continued in Section III as Column 24, height of females.
37. Computed from data of private cases furnished by Dr. Freeman, F 149, height of females.
38. Bib. 403, 1899, New York, negro asylum children. Continued in Section III as Column 39, height of females.
39. Bib. 581, 1882, Milwaukee, school children, M and F 228.
40. Bib. 114, 1861, London.
41. Bib. 663, 1878, all classes. Continued in Section III as Column 62, height of females.
42. Bib. 827, 1911, all England, F 114, 903. Continued in Section III as Column 65, height of females.
43. Bib. 827, 1911, county education areas F 58,603. Continued in Section III as Column 66, height of females.
44. Bib. 827, 1911, urban education areas, F 56,300. Continued in Section III as Column 67, height of females.
45. Bib. 628, 1836, F 10 at each age. Continued in Section III as Column 76, height of females.
46. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 77, height of females.
47. Bib. 190, 1884, F 344.
48. 645, 1905. Continued in Section III as Column 87, height of females.
49. Bib. 723, 1901, Halle, F 285. Continued in Section III as Column 92, height of females.
50. Bib. 865, 1911, F 223. Continued in Section III as Column 103, height of females.
51. Bib. 573 and 574, 1875-79, Turin. Continued in Section III as Column 104, height of females.
52. Bib. 528, 1909. Continued in Section III as Column 107, height of females.
53. Computed from data of private cases furnished by Dr. Freeman, M 508.
54. Bib. 581, 1882, Milwaukee, school children, M and F 228.
55. Bib. 114, 1861, London.
56. Bib. 663, 1878, all classes. Continued in Section III as Column 54, weight of males.
57. Bib. 827, 1911, all England, M 119,427. Continued in Section 111 as Column 66, weight of males.
58. Bib. 827, 1911 county education areas, M 60,550. Continued in Section III as Column 67, weight of males.
59. Bib. 827, 1911, urban education areas, M 58,877. Continued in Section III as Column 68, weight of males.
60. Bib. 628, 1836, M 10 at each age. Continued in Section III as Column 74, weight of males.
61. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 76, weight of males.
62. Bib. 375, 1911, taken from Heubner. Continued in Section III as Column 79, weight of males.

63. Bib. 723, 1901, Halle, M 345. Continued in Section III as Colur 98, weight of males.
64. Bib. 573 and 574, 1875-79, Turin. Continued in Section III Column 122, weight of males.
65. Bib. 528, 1909. Continued in Section III as Column 127, weig of males.
66. Bib. 529, 1893. Continued in Section III as Column 129, weig of males.
67. Computed from data of private cases furnished by Dr. Freema F 393.
68. Bib. 581, 1882, M and F 228.
69. Bib. 114, 1861, London.
70. Bib. 663, 1878, all classes. Continued in Section III as Colun 38, weight of females.
71. Bib. 827, 1911, all England, F 138,253. Continued in Section I as Column 40, weight of females.
72. Bib. 827, 1911, county education areas, F 10,101. Continued Section III as Column 41, weight of females.
73. Bib. 827, 1911, urban education areas, F 56,300. Continued Section III as Column 42, weight of females.
74. Bib. 832, 1884. Continued in Section III as Column 48, weigl of females.
75. Bib. 628, 1836 F 10 at each age. Continued in Section III Column 49, weight of females.
76. Bib. 838, 1906, Paris, poorer class. Continued in Section III Column 50, weight of females.
77. Bib. 375, 1911, taken from Heubner. Continued in Section III Column 53, weight of females.
78. Bib. 723, 1901, Halle, F 285. Continued in Section III as Colum 61, weight of females.
79. Bib. 573 and 574, 1875-79, Turin. Continued in Section III Column 74, weight of females.
80. Bib. 528, 1909.
81. Bib. 529, 1893.
82. 1920, Iowa, M 18,770. See page 65.
83. Bib. 185, about 1915, M 5602.
84. Bib. 718, 1892, M 823.
85. 1920, Iowa, F 18,188. See page 65.
86. Bib. 185, about 1915. F 4281.
87. Bib. 718, 1891-92, F 736.
88. 1920, Iowa, M 18,770. See page 65.
89. Bib. 185, about 1915, M 5602.
90. Bib. 718, 1891-92, M 823.
91. 1920, Iowa, F 18,188. See page 65.
92. Bib. 185, about 1915, F 4821.
93. Bib. 718, 1891-92, F 736.

III. SCHOOL CHILDREN AND ADULTS
HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	1b. Baldwin[1]	1a. Baldwin[2]	2a. Baldwin[3]	2b. Baldwin[4]	3. Barnes[5]	4. Beyer[6]	5a. Boas[7]	6. Boas[8]	5b. Boas[9]	7. Boas[10]	8a. Boas[11]
5		102.2	110.8						105.9	104.8	112.0
5½		109.2	111.7								
6	116.1	115.3	115.3		112.0		111.9	113.7	111.6		112.7
6½	119.1	118.5	118.4								
7	120.7	121.8	121.3	122.7	114.3		117.9	118.0	116.8	108.9	127.0
7½	125.0	122.7	122.7	125.5							
8	127.8	125.7	126.8	127.8	120.9		122.8	124.8	122.1	118.2	122.2
8½	130.8	125.9	128.2	129.2							
9	131.1	130.5	131.0	132.3	125.2		127.8	128.3	126.9	127.0	126.0
9½	133.9	132.6	134.2	135.0							
10	135.9	136.3	136.1	136.4	131.8		132.9	133.4	131.8		135.7
10½	138.9	139.1	139.1	138.8							
11	138.9	140.6	140.6	141.9	135.9		137.4	137.9	136.2	144.8	141.0
11½	142.0	144.0	144.0	144.2							
12	145.0	145.2	144.2	146.2	140.0		142.6	142.6	140.7		145.0
12½	147.1	146.7	148.7	148.9							
13	149.9	147.9	150.5	151.7	144.3		147.9	148.2	146.0		143.0
13½	151.9	151.1	155.1	154.7							
14	154.7	155.0	156.7	157.8	151.6		154.6	155.6	152.4	146.6	156.9
14½	159.0	157.9	160.3	162.1							
15	163.8	161.8	162.4	166.6	157.0	162.1	162.0	163.2	159.7		162.6
15½	164.3	165.4	167.5	168.1							
16	166.9	166.8	169.6	169.7	163.8	167.5	166.0	166.8	164.9		159.7
16½	166.4	171.1	172.6	172.2							
17	168.9	171.4	169.9	173.9	170.4	170.3	168.6		168.9		171.8
17½	168.9	171.3	175.2	173.2							
18	168.9	171.4	173.8	176.8	171.7	170.9			171.1	165.4	167.8
18½			173.9	178.1							
19						172.5				177.0	172.0
20						174.0				174.7	169.5
21						174.2					172.0
22						173.9					175.2
23						174.3				177.4	175.0
24											175.7
25										165.0	
27										163.6	
28										160.4	
30										158.1	
34										160.2	
35										161.8	
40										170.0	
										**	**

HEIGHT OF MALES IN CENTIMETERS

Age in Years	American										
	8b. Boas[12]	8c. Boas[13]	8d. Boas[14]	8e. Boas[15]	8f. Boas[16]	8g. Boas[17]	8h. Boas[18]	8i. Boas[19]	8j. Boas[20]	8k. Boas[21]	8l. Boas[22]
5	105.7	104.6	106.4	104.2	102.7	101.8			101.0	101.0	99.0
5½											
6	110.7	109.6	107.8	108.7	108.9	107.3		108.2	110.6	111.5	108.7
6½											
7	116.0	115.6	114.5	114.6	113.1	112.9	119.5	111.0	111.7	115.9	108.5
7½											
8	122.5	120.6	119.3	122.3	119.2	116.2	122.2	124.0	118.2	119.0	118.3
8½											
9	128.5	126.6	126.5	127.0	125.2	124.2	125.0		128.1	124.0	130.0
9½											
10	132.7	130.7	139.5	131.6	129.4	129.2	129.4	129.7	135.1	131.5	127.7
10½											
11	137.7	138.4	137.0	135.9	134.5	134.3	133.6	143.0	134.7	134.7	138.0
11½											
12	141.1	142.1	135.3	140.6	138.4	136.4	136.4		140.0	139.2	145.2
12½											
13	147.9	144.7	143.0	145.8	142.7	142.2	141.6	150.5	148.1	145.1	
13½											
14	152.3	147.7	153.3	152.4	147.0	147.3	148.3		150.4	150.3	155.5
14½											
15	155.5	153.7	151.0	155.3	153.1	149.9	155.8	161.0	155.2	151.7	148.0
15½											
16	162.7	158.0	173.0	159.8	159.0	158.4	126.0		160.7	163.5	170.0
16½											
17	167.6			164.1	159.5	160.2	164.0	171.0	165.0	171.0	
17½											
18	175.0	173.0	165.0	168.8	169.5	169.0	162.0	168.0	167.7	162.5	180.0
18½											
19	171.2			167.8		154.5		167.7	167.0	163.5	160.7
19½											
20	168.6				163.0		160.0	170.0	171.0	168.5	160.8
20½											
21	171.7							166.0	167.6	169.5	171.5
22	171.0							168.2	165.4	167.0	169.5
23	169.0							171.1	159.5	163.5	167.3
24	171.3							171.5	161.0	165.3	166.3
25	174.5							174.3	170.1	162.0	169.5
26											
27											
28			166.0								
	**	**		**				**	**	**	**

HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	8m. Boas[23]	8n. Boas[24]	8o. Boas[25]	8p. Boas[26]	9. Bowditch[27]	10. Bowditch[28]	11a. Bowditch[29]	11b. Bowditch[30]	12. Cordeiro[31]	13. Gilbert[32]	14. Gilbert[33]
5	101.2	103.0	103.7		105.6						
5½											
6	106.0	108.6	109.5		111.1					114.3	114.3
6½											
7	114.1	114.1	114.3		116.2					119.6	121.4
7½											
8	120.9	120.2	119.1		121.3					124.2	126.0
8½							121.2	122.2			
9	125.5	126.3	122.9	132.0	126.2	132.1				130.2	130.3
9½							126.4	127.1			
10	129.4	130.2	127.4		131.3	135.9				134.6	135.4
10½							131.0	132.5			
11	135.6	132.9	132.9		135.5	139.6				142.0	140.2
11½							135.1	136.8			
12	138.1	138.4	136.7	136.3	140.0	144.2				144.8	145.0
12½							139.5	142.1			
13	143.9	142.7	140.7	139.2	145.3	151.4			149.9	149.4	149.1
13½							144.5	147.7			
14	150.5	148.0	147.8	150.6	152.1	156.2			155.2	150.5	156.7
14½							150.7	153.8			
15	154.7	152.7	151.2	164.0	158.4	163.1			161.2	159.5	164.3
15½											
16	159.0	159.5	155.6	163.0	165.1	167.2			165.0	166.9	169.4
16½											
17	162.9	165.0	161.7		168.1	171.3				170.4	173.2
17½											
18	163.7	163.1	165.8		169.3	171.3					174.2
18½											
19	165.0	164.8	165.3								175.3
19½											
20		165.7	162.3	163.5							
20½											
21		167.1	162.5								
22		164.9	165.5								
23		167.7	167.7								
24		166.4	163.4								
25		163.7	163.0								
26	**	**	**								
27											
28											
29											
30											
31											

HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	15a. Greenwood[34]	15b. Greenwood[35]	16b. Greenwood[36]	16a. Greenwood[37]	16c. Greenwood[38]	17. Hall[39]	19a. Hastings[40]	19b. Hastings[41]	21. Hastings[42]	20. Hastings[43]	22. Hitchcock[44]
5									105.7	105.6	
5½											
6									110.6	110.5	
6½											
7									115.7	115.5	
7½											
8									121.3	121.1	
8½											
9						130.1			125.9	125.6	
9½											
10						136.9			130.9	130.7	
10½											
11	132.8	127.5	129.5		132.1	140.0			134.9	134.7	
11½											
12	135.4	128.5	135.5	137.1	134.6	144.0			140.3	140.0	
12½											
13	140.7	137.2	136.5	139.1	142.2	154.9			145.0	143.8	
13½											
14	145.5	141.5	142.2	148.8	143.8	158.2			151.0	150.8	
14½											
15	148.6	146.8	149.6	150.0	148.8	165.9			158.1	157.9	
15½											
16	159.5	157.7	154.9	158.5	158.5	168.9			163.7	163.4	171.2
16½											
17			163.7		162.3	170.4	168.1	169.2		169.7	172.5
17½											
18			165.1		164.6	170.9	169.1	170.1		170.8	173.2
18½											
19					169.3	171.5	167.8	170.9		171.5	173.2
19½											
20						171.7	172.2	172.6		171.9	173.0
20½											
21						172.0	172.0	172.8			173.0
22							173.1	173.0			173.2
23							173.4	173.5			173.0
24							174.5	173.8			173.2
25							174.8	174.5			173.2
26							173.8	174.8			175.0
27							173.5	173.5			
28							174.4	174.0			
29							172.9	173.0			
30							175.7	175.7			
31											

HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	23a. Hrdlička[45]	23b. Hrdlička[46]	23c. Hrdlička[47]	24a. Macdonald[48]	24b. Macdonald[49]	24c. Macdonald[50]	25. Peckham[51]	26b. Peckham[52]	27. Porter[53]	28. Porter[54]	29. Robertson[55]
5		104.4	96.1				107.4				
5½											
6	102.5	110.1	105.1	113.0	112.1	114.3	112.0		109.0	108.9	117.1
6½											
7	111.3	114.6	112.0	116.8	116.4	116.9	117.1		114.1	114.0	121.7
7½											
8	113.3	119.6	115.2	121.4	121.1	121.7	122.1		119.1	119.1	127.8
8½											
9	119.7	125.1	121.2	126.2	125.8	126.8	127.0		124.5	124.4	132.6
9½											
10	123.4	127.1	124.8	131.3	130.1	132.1	131.7		128.8	128.9	135.9
10½											
11	128.7	136.0	131.5	135.1	133.9	135.9	136.6		133.9	133.9	142.2
11½											
12	133.7	138.1	136.2	140.0	139.3	140.6	139.7		138.2	138.2	151.6
12½											
13	136.8	139.2	142.0	144.3	143.2	144.5	146.1		143.0	142.9	151.4
13½											
14	122.5	150.4	144.9	150.1	149.0	151.6	152.2		148.1	148.6	156.7
14½											
15	135.7	145.5	146.2	157.0	157.2	165.2	158.2	160.9	154.9	154.9	
15½											
16		150.0	161.8	163.3	160.2	170.1	165.4	165.4	160.3	160.3	
16½											
17			155.4	167.6	167.2		169.2	167.7	165.1	165.1	
17½											
18				170.4				172.4		170.4	
18½											
19								173.0			
19½											
20								174.1			
20½											
21								174.7			
22								174.4			
23								175.2			
24								176.0			
25								177.1			
26											
27											
28											
29											

HEIGHT OF MALES IN CENTIMETERS

Age in Years	American								
	30. Smedley[56]	31. Sternberg[57]	32a. Sternberg[58]	32b. Sternberg[59]	32c. Sternberg[60]	33b. Stiles & Wheeler[62]	33a. Stiles & Wheeler[61]	34. West[63]	35. Young[64]
5								109.7	
6	110.7					112.6	112.3	112.8	117.0
6½	113.3								
7	115.8					119.5	119.5	117.1	125.0
7½	118.4								
8	120.9					123.2	122.9	122.3	132.0
8½	123.5								
9	126.1					127.4	127.6	127.0	135.3
9½	128.8								
10	130.9					132.6	132.8	134.0	137.1
10½	133.1								
11	135.1					136.4	136.5	138.8	141.7
11½	137.2								
12	139.6					142.2	141.8	142.9	149.0
12½	141.9								
13	145.5					148.1	147.6	147.6	155.0
13½	149.1								
14	151.9					151.9	151.5	154.3	157.2
14½	154.8								
15	158.1					159.1	159.5	162.3	
15½	161.4								
16	164.1	162.8			164.0			165.9	
16½	166.7					168.8	169.2		
17	167.9	166.8			168.8			168.4	
17½	169.1		169.3						
18	171.3	168.6		167.9	171.3			169.9	
18½	173.4		171.5						
19		170.4		169.3	171.2			171.2	
19½			169.3						
20		171.5		171.9	173.0			174.0	
20½			170.6						
21		172.2	170.8	170.8	170.7			170.4	
22		172.5	170.3	170.6	171.9				
23		172.8	171.5	171.1	172.1				
24		172.8	170.0	170.6	171.6				
25		172.9	171.3	171.4	171.6				
26		173.0	170.3	171.3	171.8				
27		173.0	171.2	171.3	171.3				
28		173.1	170.9	170.5	171.6				
29		173.2	170.7	171.5	172.2				
30		173.2	170.7	168.2	172.1				
		**	**	**	**				

HEIGHT OF MALES IN CENTIMETERS

Age in Years	Canadian	Amer. and Engl.	English								
	36. Boas[65]	37. Stephenson[66]	39a. Elderton[67]	39b. Elderton[68]	40. Galton[69]	41. Galton[70]	42. Kerr[71]	43. Maclaren[72]	44a. Roberts[73]	44b. Roberts[74]	44c. Roberts[75]
5	106.3	104.9			97.8	104.1			104.2	104.8	104.6
5½											
6	111.0	111.5	104.9	109.2	104.1	111.8	121.0		111.8	109.1	109.7
6½											
7	116.2	116.5	109.2	113.8	111.8	116.8	126.0		116.8	114.9	114.3
7½											
8	121.4	120.4	114.6	119.1	116.8	119.4	131.5		119.5	119.3	119.4
9	126.2	126.2	119.4	124.5	119.6	126.2	137.0		126.2	124.3	125.1
10	131.2	131.5	124.0	129.3	126.2	131.6	142.0	135.9	131.7	127.8	128.4
11	135.5	135.8	128.5	133.6	131.6	135.9	148.0	139.7	135.9	130.1	130.9
12	139.9	139.8	132.8	137.7	135.9	139.7	155.0	144.2	139.7	133.4	134.7
13	145.5	144.9	136.7	142.0	139.7	144.8	161.0	148.6	144.6	138.8	142.2
14	150.6	151.4	140.2	146.6	144.5	150.6	166.0	154.3	150.7	142.4	146.7
15		158.2			150.6	158.0	170.0	160.0	158.1	150.1	153.9
15½									163.4		
16		164.2			158.0	163.3	172.5	165.1		162.3	159.8
16½									168.3		
17		168.2			163.3	168.2	174.0	170.2		167.4	163.7
17½									170.1		
18		169.7			168.2	169.9		172.7		169.6	166.3
18½									170.9		
19					170.2	170.9				170.7	167.7
19½									171.5		
20					170.9	171.5				170.8	168.4
20½									171.8		
21					171.5	171.7			171.9	171.5	
22					171.7				171.4	171.8	169.2
23									172.0		
24									172.1		
25									172.2		
26									172.5		169.4
27									172.0	172.5	
28									172.4		
33									172.4		
36										170.7	
38									173.0		
39									**		

HEIGHT OF MALES IN CENTIMETERS

	English										
Age in Years	44d. Roberts[76]	44h. Roberts[77]	44i. Roberts[78]	45. Shuttleworth[79]	46. Stanway[80]	47a. Stephenson[81]	47b. Stephenson[82]	48. Thorne[83]	49a. Tuxford & Glegg[84]	49b. Tuxford & Glegg[85]	49c. Tuxford & Glegg[86]
5				104.1					103.0	103.2	102.7
5½											
6				109.2					108.0	108.6	107.5
6½											
7		117.3		114.3					114.7	115.3	114.3
7½											
8		120.2		119.4					119.3	119.5	119.0
8½											
9		127.5	130.8	124.5				128.3	124.7	126.6	123.7
9½											
10	135.6	133.9	135.4	129.5	128.3	128.3	134.6	139.1	129.4	130.0	129.1
10½											
11	139.4	136.8	143.3	134.6	130.3	130.8	138.4	143.5	134.2	135.2	133.7
11½											
12	144.6	141.0	146.6	139.7	135.1	135.9	143.5	144.2	139.8	140.2	138.9
12½											
13	149.3	148.1	152.2	146.1	139.2	141.0	148.6	152.4	142.5	142.6	142.4
13½											
14	155.2	152.0	157.7	152.4	144.0	147.3	154.9	158.8	147.1	147.8	146.8
14½											
15	161.2	159.0	163.1	157.5	150.1	153.7	161.3	165.1			
15½	168.7										
16		165.4	167.9	162.6	158.0	160.0	168.9	168.3			
16½	172.4										
17		169.5	170.7	166.4	162.1	163.8	172.7				
17½	173.5										
18		172.7		168.9		166.4	174.0				
18½	174.6										
19		175.7		170.2		167.6	174.5				
19½	175.6										
20				170.8		168.2	175.3				
20½	175.7										
21	177.6					168.9	175.3				
22	174.0										
23	175.1										
27	175.4			171.5							
30						168.9	175.3				

HEIGHT OF MALES IN CENTIMETERS

	Norwegian				Swedish		Danish		Belgian		Fren.
Age in Years	50 Schiötz[87]	51a Schiötz[88]	51b Schiötz[89]	51c Schiötz[90]	52a Key[91]	52b Key[92]	53a Hertel[93]	53b Hertel[94]	55 Quetelet[95]	56 Zeising[96]	57 Godin[97]
5									98.8		
5½											
6		116.0			116.0		112.0		104.7		
6½											
7		119.1	124.1	120.1	121.0		115.1		110.5		
7½											
8		122.9	128.2	126.2	126.0		119.9		116.2	125.4	
8½						122.0					
9		127.6	135.0	127.7	131.0		125.0		121.8	126.0	
9½						125.0					
10		132.7	140.2	132.8	133.0		130.1		127.3	130.5	
10½						129.0					
11		136.5	142.7	136.7	136.0		134.9		132.5	132.3	
11½						134.0		141.0			
12	144.0	140.4	147.5	141.8	140.0		137.9		137.5	136.0	
12½						137.0		143.0			
13	148.7	145.2	152.3	148.5	144.0		143.0		142.3	140.0	
13½						142.0		146.0			145.2
14	154.2	150.0	161.1	151.2	149.0		149.1		146.9	143.0	146.6
14½						144.0		151.0			149.8
15	163.6				156.0		156.0		151.4		153.6
15½						152.0					155.5
16	167.0				162.0		164.1		155.5		158.1
16½											160.1
17	170.6				167.0		166.9		159.5		161.9
17½											163.6
18					170.0		169.9		163.1		
18½											
19					171.0		169.9		165.6		
19½											
20					172.0				166.9		
20½											
21											
22											
23											
24											
25									168.2		
26											
27											
30									168.7		
40									168.7		

HEIGHT OF MALES IN CENTIMETERS

	Fr.	German									
Age in Years	58 Variot & Chaumet[98]	59a Ascher[99]	59b Ascher[100]	61 Carstädt[101]	62 Daffner[102]	63 Daffner[103]	64 Geissler[104]	65a Geissler and Uhlitzsch[105]	65b Geissler and Uhlitzsch[106]	66b Hasse[107]	66a Hasse[108]
5											
5½	103.3										
6				109.3							
6½	109.9	110.0	110.0	111.8			110.2	110.4	108.1		
7				113.8							
7½	114.4	118.0	115.0	116.8			114.4	113.8	111.4		
8				118.9							
8½	119.7	122.0	120.0	121.6			119.4	119.7	117.4	118.6	120.5
9				123.7							
9½	125.0	131.0	126.0	126.0			123.9	125.0	119.9	122.9	126.0
10				128.5							
10½	130.3	131.0	129.0	130.8			129.1	128.3	125.6	128.0	130.9
11				133.3							
11½	133.6	133.0	135.0	135.6			132.4	132.3	130.0	131.7	134.2
12				138.1							
12½	137.6	145.0	139.0	140.4			138.2	137.6	134.8	137.8	139.2
13				143.3	147.7						
13½	145.1	142.0	143.0	145.8			140.7	143.0	138.3	140.5	141.2
14				149.1	148.9						
14½	153.8			152.3						144.3	148.3
15				156.6	163.2						
15½	159.6			159.9							
16				162.8	162.5	162.6					
16½											
17					167.6	164.1					
17½											
18					171.4	166.9					
18½											
19					172.3	168.9					
19½											
20					173.7	170.4					
21					167.7	172.0					
22					176.0	173.5					
23						175.5					
24						175.5					
25						180.1					
26						182.1					

HEIGHT OF MALES IN CENTIMETERS

	German										
Age in Years	67 Kotelmann[109]	68 Landsberger[110]	69a Peiper[111]	69b Peiper[112]	69c Peiper[113]	70 Radosavljevich[114]	71 Ranke[115]	72 Reuter[116]	73a Rietz[117]	73b Rietz[118]	74 Samosch[119]
5							99.6				
5½											
6		106.9				112.4	105.9	112.0	118.1	113.4	109.0
6½			112.1	112.8	112.1						
7		112.3				117.2	111.7	115.0	121.8	117.0	115.0
7½			117.0	116.8	117.0						
8		117.3				122.1	116.9	121.0	127.3	121.4	119.0
8½			121.8	121.2	122.1						
9	128.5	122.1				127.1	121.5	127.0	131.2	126.5	125.0
9½			126.6	126.0	126.8						
10	130.7	125.4				132.0	127.2	131.0	135.7	130.9	129.0
10½			131.4	131.2	131.4						
11	135.0	130.0				135.1	130.8	133.0	139.5	135.3	133.0
11½			135.9	135.4	136.2						
12	139.9	135.2				140.4	135.4	138.0	145.4	139.7	137.0
12½			140.5	141.0	140.3						
13	143.0	139.3				147.6	139.7	142.0	150.6	144.7	142.0
13½			145.5	145.5	145.6						
14	148.8					152.2	145.3	149.0	156.0	146.6	151.0
14½											
15	154.2					160.2	149.6		162.4		
15½											
16	161.8					164.2			165.5		
16½											
17	166.9					167.1			168.7		
17½											
18	168.4					172.0			170.7		
18½											
19	166.9					173.4			170.3		
19½											
20	167.1					174.0					
20½											
21	170.0										
22	176.5										
23											
24											
25											
26											

HEIGHT OF MALES IN CENTIMETERS

	German										
Age in Years	75a Schlesinger[120]	75b Schlesinger[121]	75c Schlesinger[122]	75d Schlesinger[123]	75e Schlesinger[124]	75f Schlesinger[125]	76 Schmid-Monnard[126]	77a Schmidt[127]	77b Schmidt[128]	77c Schmidt[129]	78 Thoma[130]
5							99.7				
5½											
6	115.0	110.5	105.5	121.0	115.5	110.0	110.0				
6½								109.3			
7	121.0	113.0		124.5	118.0	115.5	115.9				
7½								114.3			
8	127.0	117.0	114.0	129.0	122.0	120.0	119.5				
8½								119.8	121.0	118.4	121.8
9	130.5	124.5	110.5	135.5	128.5	126.0	123.8				
9½								124.9	125.6	123.9	124.6
10	134.5	126.5	109.0	138.0	131.5	126.5	127.8				
10½								128.2	129.6	126.7	128.9
11	141.0	131.5	118.0	142.5	134.0	127.0	132.9				
11½								132.9	134.0	131.5	134.1
12	145.5	137.0	121.5	148.0	140.0	132.0	137.8				
12½								137.8	138.5	136.9	138.9
13	152.5	142.5	137.0	153.5	145.0	139.0	142.0				
13½								142.2	143.4	140.7	142.3
14	158.5	147.0	141.0	160.5	150.0	145.0	147.3				
14½											159.7
15	162.5	153.5	145.0	168.5	157.5	152.5					
15½											163.3
16	166.5	156.5	147.0	170.0	166.0						
16½											166.0
17				172.0	167.0						
17½											166.6
18				173.0	170.5						
18½											167.5
19				173.5	172.0	166.0					
19½											
20				174.0	166.0						
20½											
21							**				
22											
23											
24											
25											
26											

HEIGHT OF MALES IN CENTIMETERS

	Pol.	Swiss				Russian					
Age in Years	79 Suligowski[131]	80 Combe[132]	81 Ernst[133]	83a Niceforo[134]	83b Niceforo[135]	84 Dementiew[136]	86a Erismann[137]	86b Erismann[138]	87a Kosmowski[139]	88 Makower[140]	89c Michailoff[141]
5											
5½											
6											
6½											
7		117.4					112.0				
7½									116.4		
8		122.4					117.9	120.1		123.2	
8½			126.1						117.3		120.5
9	126.0	127.0					122.7	122.4		126.3	
9½			126.1						121.6		124.2
10	129.8	131.3		128.9	134.2	125.1	130.8	126.3		130.3	
10½			131.2						126.7		128.6
11	133.9	135.4		134.2	135.2	129.0	135.6	129.9		134.6	
11½			134.5						130.9		131.9
12	137.4	139.7		138.8	140.5	133.7	140.2	134.4		139.9	
12½			138.8						135.8		135.6
13	143.5	144.5		140.5	144.4	137.1	145.3	137.7		146.9	
13½			143.7						138.5		140.5
14	149.1			146.2	150.1	141.3	150.1	141.2		151.3	
14½			145.3						150.0		145.5
15	156.2					147.2	156.5	146.7		157.7	
15½											
16	161.3					152.7	161.3	153.2		161.3	
16½											
17	165.6					158.3	164.1	158.6		162.3	
17½											
18	166.4					162.4		161.8		162.9	
18½											
19	165.9					163.8		163.6		162.7	
19½											
20	168.7					164.2		164.4		163.4	
21	166.9							164.4		164.1	
22								164.6			
23								165.2			
24								165.0			
25								165.1			
26								164.9			
27								165.3			
28								165.0			
29								165.4			
30								**			

HEIGHT OF MALES IN CENTIMETERS

	Russian									
Age in Years	89a Michailoff[142]	89b Michailoff[143]	91 Sack[144]	92a Spielrein[145]	92b Spielrein[146]	93 Starkow[147]	94a Weissenberg[148]	94b Weissenberg[149]	94c Weissenberg[150]	94d Weissenberg[151]	95 Wiazemsky[152]
5										100.7	
5½											
6					113.1					108.3	
6½											
7				118.0	116.9					112.7	
7½											
8				123.9	121.1					116.7	
8½	117.7	117.8	124.8								
9				127.1	123.3					122.0	
9½	121.0	122.8	130.3								132.0
10				132.2	129.0		124.2	124.7	126.5	125.4	
10½	126.6	130.9	133.8								133.4
11				135.1	136.0	133.6	125.8	128.9	131.4	130.1	
11½	129.6	135.6	138.0								138.2
12				137.3	139.0	137.0	130.8	135.7	137.8	136.2	
12½	133.9	140.1	142.5								143.4
13				143.6	145.5	142.3	133.3	137.7	140.4	139.6	
13½	137.9	145.4	147.8								148.6
14				149.0	147.8	148.3				145.3	
14½	140.9	150.2	155.6								157.7
15					152.5	154.0				149.1	
15½	144.5	156.4	161.4								160.8
16						160.7				157.1	
16½		161.4	165.7								164.0
17						165.3				161.3	
17½		164.0	168.1								166.4
18						167.8				161.9	
18½			169.4								167.9
19						168.5				163.5	
19½			170.2								168.7
20						169.2				164.1	
20½			169.7								
21										**	
22											
23											
24											
25											
26											
27											

HEIGHT OF MALES IN CENTIMETERS

	Italian			Japanese			Chinese				Phil.
Age in Years	96a Pagliani[153]	96c Pagliani[154]	96b Pagliani[155]	99a Misawa[156]	98 Misawa[157]	99b Misawa[158]	101 Bobbitt[159]	102 Merrins[160]	103b Whyte[161]	103a Whyte[162]	104 Bobbitt[163]
5	97.0			97.5							
5½											
6	103.4			102.8							109.5
6½											
7	112.5			108.3	106.5						113.5
7½											
8	118.4			113.8	111.0						117.0
8½		115.0	122.0								
9	124.0			118.3	115.6		123.7				121.0
9½		120.0	125.4								
10	126.5			122.7	120.0		127.5				124.7
10½		125.6	128.5								
11	129.3			127.0	124.8		128.6	127.0		131.3	129.9
11½		128.5	133.6								
12	133.6			130.7	128.7		129.1	138.9	137.5	134.0	136.0
12½		132.0	137.0								
13	139.7			135.2	133.4	147.0	136.4	141.0	146.5	136.4	140.3
13½		138.6	142.5								
14	145.3			141.5	137.6	152.2	144.2	149.4	151.7	145.1	147.1
14½		140.0	150.6								
15	151.9			146.3	142.1	156.7	158.5	157.5	155.5	142.8	154.2
15½											
16	158.0				146.1	159.0		162.1	160.0	152.5	158.2
16½											
17	160.0					160.0		163.1	161.0	156.4	160.5
17½											
18	160.8							162.6	163.4	158.4	160.9
18½											
19	161.8							164.3	164.5	162.3	162.0
19½											
20								163.8			162.2
20½											
21								167.1			161.0
22								167.6			
23									**	**	
24											
25											

III. SCHOOL CHILDREN AND ADULTS. HEIGHT OF MALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. Well-to-do class, M 501, consecutive measurements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School. Well-to-do class, M 100, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, M 60, consecutive measurements. Includes data of final norms page 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, M 35, consecutive measurements. Not discussed in previous sections of our *Study*.
5. Bib. 35, 1892, Oakland M and F 4956.
6. Bib. 63, 1895, naval cadets.
7. Bib. 88, 1897, American, M 2386.
8. Bib. 88, 1897, Oakland, M 2053.
9. Bib. 88, 1897, American, M 45,151.
10. Bib. 80, 1891, half bloods and Indians, North Pacific coast.
11. Bib. 95, 1911, American born Scotch, M 84.
12. Bib. 95, 1911, American born Bohemian, M 915.
13. Bib. 95, 1911, American born Hungarian and Slovak, M 145.
14. Bib. 95, 1911, American born Polish, M 61.
15. Bib. 95, 1911, American born Hebrew, M 2339.
16. Bib. 95, 1911, American born Sicilian, M 420.
17. Bib. 95, 1911, American born Neopolitan, M 774.
18. Bib. 95, 1911, American born Italian, M 189.
19. Bib. 95, 1911, foreign born Scotch, M 63.
20. Bib. 95, 1911, foreign born Bohemian, M 155.
21. Bib. 95, 1911, foreign born Hungarian and Slovak, M 122.
22. Bib. 95, foreign born Polish, M 66.
23. Bib. 95, 1911, foreign born Hebrew, M 939.
24. Bib. 95, 1911, foreign born Sicilian, M 525.
25. Bib. 95, 1911, foreign born Neopolitan, M 437.
26. Bib. 95, 1911, foreign born Italian, M 50.
27. Bib. 109, 1875, Boston, M 13,695.
28. Bib. 110, 1879, foreign descent.
29. Bib. 110, 1879, Boston laboring class. Taken from Ernst, Bib. 241.
30. Bib. 110, 1879, Boston non-laboring class. Taken from Ernst, Bib. 241.
31. Bib. 177, 1887, U. S. navy, M 5401.
32. Bib. 294, 1895, New Haven, M 602.
33. Bib. 295, 1897, Iowa, M 50.
34. Bib. 317, 1890, American whites, M and F 724.
35. Bib. 317, 1890, negroes, M and F 223.
36. Bib. 317, 1890, negroes, M and F 574.
37. Bib. 317, foreign, M and F 385.
38. Bib. 317, 1890, Kansas City white, M and F 2619.
39. Bib. 341, 1895, Pennsylvania, M 2434.
40. Bib. 356, 1902, Amherst College, M 1321.
41. Bib. 356, 1902, Amherst College, M 2106.
42. Bib. 356, 1902, American, M 5476.
43. Bib. 356, 1902, Nebraska, M 7700.
44. Bib. 390, 1900, Amherst College, M 4880.
45. Bib. 403, 1899, Italian.
46. Bib. 403, 1899, New York, negro asylum children.
47. Bib. 403, 1899, New York, white asylum children.
48. Bib. 490, 1897-1898, Washington, D. C., M 7953.
49. Bib. 490, 1897-98, Washington, D. C., laboring class. Taken from Ernst, Bib. 241.

50. Bib. 490, 1879-98, Washington D. C., non-laboring class. Taken from Ernst, Bib. 241.
51. Bib. 580, 1881, Milwaukee, M 4773.
52. Bib. 580, 1881, Beloit College, M 533.
53. Bib. 614, 1893, St. Louis, M 16,295.
54. Bib. 615, 1894,St. Louis, M 15,525.
55. Bib. 669a, 1916, Oakland.
56. Bib. 764, 1900, Chicago, M 2788.
57. Bib. 779, 1893, American born whites fit for army, M 190,621.
58. Bib. 779, 1893, foreign born white, U. S. army, M 2388.
59. Bib. 779, 1893, negroes, U. S. army.
60. Bib. 779, 1893, native white accepted recruits, M 4547.
61. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, M 771.
62. Bib. 782, 1915, southern states, homes of good sanitary condition, M 593.
63. Bib. 873, 1896, Worcester, M and F 3250.
64. Bib. 900, 1913, Chicago, favored class, M 201.
65. Bib. 95, 1911, Toronto.
66. Bib. 778, 1888.
67. Bib. 229, 1914, Glasgow, poorer class.
68. Bib. 229, 1914, Glasgow, better class.
69. Bib. 281, 1883, schools, military and naval colleges, M and F 29,405.
70. Bib. 281, 1883, all classes.
71. Bib. 427, 1918.
72. Bib. 495, 1895.
73. Bib. 663, 1878, all classes, M and F 30,000.
74. Bib. 663, 1878, soldiers, police etc., M 29,525.
75. Bib. 663, 1878, artisan class, M 13,931.
76. Bib. 663, 1878, favored class, M 7709.
77. Bib. 663, 1878, towns, M 2613.
78. Bib. 663, 1878, Friends' school, M 4661.
79. Bib. 752, 1884, general population.
80. Bib. 773, 1833, Manchester.
81. Bib. 778, 1888, laboring class.
82. Bib. 778, 1888, non-laboring class.
83. Bib. 819, 1904, London, scholarship boys, M 1710.
84. Bib. 827, 1911, all England, M 261,531.
85. Bib. 827, 1911, county education areas, M 120,237.
86. Bib. 827, 1911, urban education areas, M 141,294.
87. Bib. 706, 1919, M 231.
88. Bib. 704, 1917, M 4463.
89. Bib. 704, 1917, Kristiania, better class, M 519.
90. Bib. 704, 1917, Kristiania Volksschule, better class, M 359.
91. Bib. 431, 1889, M 15,000.
92. Bib. 431, 1889, Volksschulen, M 15,000. Taken from Ernst, Bib. 241.
93. Bib. 368, 1882, M 17,134.
94. Bib. 368, 1882, höhere Schulen.
95. Bib. 628, 1836, M 10 at each age.
96. Bib. 905, 1854.
97. Bib. 299, 1903.
98. Bib. 838, 1906, Paris, poorer class.
99. Bib. 18, 1912, Hamm.
100. Bib. 18, 1912, Königsberg.
101. Bib. 160, 1888, Breslau, höhere Bürgerschule, M 600.
102. Bib. 191, 1884, M 700.
103. Bib. 190, 1884.
104. Bib. 291 & 292, 1888, Gohlis-Leipzig Bürgerschule, M 1386.
105. Bib. 291 & 292, 1888, Freiberg Bürgerschule, M 10,343.

106. Bib. 291 & 292, 1888, Freiberg mountaineers' children, Volksschulen.
107. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 2. Taken from Ernst, Bib. 241.
108. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 1. Taken from Ernst, Bib. 241.
109. Bib. 449, 1879, Hamburg, Gelehrtenschulen, M 515.
110. Bib. 457, 1888, Posen, M 37.
111. Bib. 583, 1912, Pommerania Volksschulen, city and country combined, M 42,528.
112. Bib. 583, 1912, Pommerania Volksschulen, city children, M 14,914.
113. Bib. 583, 1912, Pommerania Volksschulen, country children, M 28,334.
114. Bib. 639, 1913, Mostar, Austria, M 1360.
115. Bib. 645, 1905, Kiel and Lübeck.
116. Bib. 653, 1903, Pommerania. Taken from Stratz, Bib. 793.
117. Bib. 657, 1903, Berlin Gymnasium, M 1740.
118. Bib. 657, 1903, Berlin Volksschulen, M 1496.
119. Bib. 687, 1904, Breslau. Taken from Stratz, Bib. 793.
120. Bib. 714, 1917, poorer class, good development.
121. Bib. 714, 1917, poorer class, medium development.
122. Bib. 714, 1917, poorer class, poor development.
123. Bib. 714, 1917, well-to-do class, good development.
124. Bib. 714, 1917, well-to-do class, medium development.
125. Bib. 714, 1917, well-to-do class, poor development.
126. Bib. 723, 1901, Halle, M 958.
127. Bib. 724, 1892, Saalfeld Bürgerschulen.
128. Bib. 724, 1892, Saalfeld, country children. Taken from Ernst, Bib. 241.
129. Bib. 724, 1892, Saalfeld, city children. Taken from Ernst, Bib. 241.
130. Bib. 812 and 813, 1882, Heidelberg Volksschulen, M 480. Taken from Wiazemsky, Bib. 878.
131. Bib. 796, 1887, Radom, M 1133.
132. Bib. 175, 1896, Lausanne, M and F 2000.
133. Bib. 241, 1906, Zürich Volksschulen, M 175.
134. Bib. 549, 1903, Lausanne, poor class. Taken from Wiazemsky, Bib. 878.
135. Bib. 549, 1903, Lausanne, rich class. Taken from Wiazemsky, Bib. 878.
136. Bib. 204, 1889, Moscow factory workmen, M 5936. Taken from Wiazemsky, Bib. 878.
137. Bib. 238 and 239, 1888, Moscow, M 3212.
138. Bib. 238 and 239, 1888, Central Russia, laboring class, M 45,525.
139. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
140. Bib. 496, 1914, Wilna, Jewish children, M about 400.
141. Bib. 523, 1887, Elementarschulen. Taken from Ernst, Bib. 241.
142. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
143. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
144. Bib. 683, 1893, Moscow, Gymnasium.
145. Bib. 768, 1916, Rostow, in school, M 496.
146. Bib. 768, 1916, Rostow, not in school, M 304.
147. Bib. 774, 1897, cadets. Taken from Wiazemsky, Bib. 878.
148. Bib. 865, 1911, poor class.
149. Bib. 865, 1911, middle class.
150. Bib. 865, 1911, wealthy class.
151. Bib. 865, 1911, South Russian Jews, M 1899.
152. Bib. 878, 1907, St. Petersburg, M 1811.
153. Bib. 573 and 574, 1875-79, Turin, M 1098.

154. Bib. 573 and 574, 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
155. Bib. 573 and 574, 1875-79, Turin, well-to-do class. Taken from Ernst, Bib. 241.
156. Bib. 528, 1909.
157. Bib. 528, 1909.
158. Bib. 528, 1909.
159. Bib. 103, 1909, M 60.
160. Bib. 519, 1910, students, M 219.
161. Bib. 876, 1918, Pekin, M 5102.
162. Bib. 876, 1918, southern provinces, M 1357.
163. Bib. 103, 1909, M 1180.

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	1b Baldwin[1]	1a Baldwin[2]	2a Baldwin[3]	2b Baldwin[4]	3 Barnes[5]	5a Boas[6]	5b Boas[7]	6 Boas[8]	7 Boas[9]	8a Boas[10]	8b Boas[11]
5		101.6	106.9				104.9		97.4	110.0	105.5
5½		109.0	110.7								
6	114.6	114.7	112.5		112.8	112.0	110.1	112.5		118.3	109.6
6½	117.4	117.6	116.9								
7	120.9	120.0	118.4	121.7	114.1	117.1	116.1	117.5		117.0	113.8
7½	122.9	122.6	122.3	126.5							
8	125.0	125.4	124.8	126.2	118.9	122.1	121.2	122.6	129.6	120.0	121.9
8½	126.2	128.0	127.5	128.5							
9	130.8	129.8	129.9	131.3	125.0	127.0	126.1	127.7		131.5	127.2
9½	130.8	132.1	133.1	133.1							
10	134.6	135.5	134.6	134.9	130.8	133.0	131.3	133.5		133.4	133.0
10½	137.7	137.3	138.6	138.2							
11	140.0	140.1	140.3	144.0	136.9	137.2	136.6	138.9		131.2	138.7
11½	143.8	144.6	144.7	143.8							
12	145.8	146.6	146.7	146.8	143.8	144.3	142.5	145.0	134.6	143.0	143.5
12½	147.6	150.7	150.4	150.6							
13	152.9	151.1	153.5	153.7	152.4	149.9	148.7	151.6	152.8	147.6	148.8
13½	154.7	153.9	155.3	156.2							
14	157.0	155.8	157.8	158.8	155.5	153.9	153.5	156.6		153.2	152.8
14½	157.5	158.7	158.9	160.3							
15	159.0	159.0	159.0	161.8	157.2	156.9	156.5	157.7		161.3	159.2
15½	159.0	160.7	158.8	162.8							
16	159.8	160.0	161.6	163.6	159.3	157.2	158.0	159.7		166.6	161.2
16½	160.0	161.8	159.5	163.6							
17	159.8	161.1	161.3	163.6	159.3	159.1	159.1	159.7		163.3	161.8
17½	161.8	162.3	162.1	163.8							
18	162.1	162.6	160.5	163.3	160.5				158.2	165.2	161.1
18½			162.5	164.1							
19				163.8						165.4	160.2
19½				165.1							
20									152.0	166.5	161.1
21										161.4	162.5
22									150.4	166.7	160.7
23									149.3	163.3	164.2
24										162.0	159.0
25										163.7	160.9
27									158.5		
28									157.7		
29									155.3		
30									154.2		
31									148.2		
33									159.8		
35									162.1		
40									147.9		
									**		

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	8c Boas[12]	8d Boas[13]	8e Boas[14]	8f Boas[15]	8g Boas[16]	8h Boas[17]	8i Boas[18]	8j Boas[19]	8k Boas[20]	8l Boas[21]	8m Boas[22]
5	103.9	102.6	103.9	101.1	100.6	103.0		104.2	102.7	103.3	100.9
5½											
6	111.9	108.6	110.3	107.9	107.4	102.5		112.0	106.5	106.5	108.3
6½											
7	114.9	113.4	115.7	112.0	111.5			116.0	112.0	116.0	111.5
7½											
8	117.7	118.9	121.3	117.5	118.1	125.0		120.0	116.0	114.5	119.4
8½											
9	125.7	127.3	124.5	124.3	122.2	125.5	119.7	123.7	126.9	120.0	123.5
9½											
10	131.9	128.7	130.2	124.8	128.3	126.0	137.5	131.7	131.0	126.0	128.7
10½											
11	136.2	135.7	135.3	133.4	135.1	133.0	130.0	133.3	139.0	129.5	135.1
11½											
12	144.5	143.0	141.9	138.2	139.5	132.5	138.7	138.2	137.4	142.0	141.5
12½											
13	143.7	145.3	148.5	144.7	144.9	133.0	143.7	145.6	147.6	146.0	147.5
13½											
14	154.5	151.0	153.3	151.6	151.3	140.0		150.0	152.4	152.0	152.3
14½											
15	157.0	158.0	153.9	151.9	153.4	156.0	158.0	157.0	154.6		155.1
15½											
16	155.6	155.7	154.7	158.2	153.4	154.0	165.0	160.3	158.4	154.4	155.3
16½											
17	157.0		155.7	155.8	156.3	160.0	157.0	160.8	152.3	148.0	155.5
17½											
18	162.0					156.2		162.7	157.9	159.0	
18½											
19	155.5						163.0	159.9	158.0	157.8	
19½											
20	151.0						170.0	158.2	157.3	153.7	
20½											
21	164.0						159.0	159.3	161.6	155.2	
22							156.0	158.9	160.0	164.5	
23							162.0	160.3	164.0	153.2	
24							159.5	155.7	159.2	155.4	
25							163.7	157.9	159.7	158.8	
26											
27											
28											
29											
30											

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	8n Boas[23]	8o Boas[24]	9 Bowditch[25]	11a Bowditch[26]	11b Bowditch[27]	13 Gilbert[28]	14 Gilbert[29]	15b Greenwood[30]	15a Greenwood[31]	16b Greenwood[32]	16c Greenwood[33]
5	100.1	101.3	104.6								
5½											
6	108.9	107.2	110.1			114.1	113.3				
6½											
7	112.9	112.5	115.6			119.1	118.9				
7½											
8	121.1	120.5	120.9			123.0	125.0				
8½				120.6	121.8						
9	125.8	123.0	125.4			129.0	130.3				
9½				125.2	127.5						
10	132.0	127.5	130.4			134.0	134.6				
10½				130.3	131.3						
11	134.6	136.3	135.7			138.6	138.4	131.1	130.8	126.5	131.3
11½				135.7	136.4						
12	140.7	141.0	141.9			147.1	147.3	135.9	135.1	134.1	133.9
12½				141.5	142.7						
13	144.8	142.4	147.8			153.4	150.4	141.0	140.7	137.2	137.2
13½				147.4	149.1						
14	150.0	149.8	152.3			155.9	156.7	144.8	145.3	144.4	145.9
14½				152.1	153.2						
15	154.1	152.2	155.2			158.8	160.8	150.1	150.4	149.2	153.2
15½											
16	155.8	154.7	156.4			158.8	160.8	153.9	157.0	156.3	158.8
16½											
17	156.9	155.5	157.3			161.5	163.8			159.5	159.8
17½											
18	156.6	156.8	157.4				164.1			167.6	160.8
18½											
19	156.5	157.6					164.1				163.1
19½											
20	157.5	156.0									
20½											
21	156.5	156.7									
22	156.1	157.7									
23	156.2	156.8									
24	155.8	155.1									
25	157.5	156.5									
26											
27											
28											
29											
30											

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	16a Greenwood[34]	18a Hanna[35]	18b Hanna[36]	20 Hastings[37]	23a Hrdlička[38]	23b Hrdlička[39]	23c Hrdlička[40]	24a Macdonald[41]	24b Macdonald[42]	24c Macdonald[43]	25 Peckham[44]
5				105.2		98.5	100.4				106.0
5½											111.2
6				109.7	105.7	109.0	106.0	112.3			116.7
6½											120.9
7				114.7	108.1	112.6	108.7	114.6	113.8	115.5	126.5
7½											
8				119.9	110.9	125.9	113.0	120.4	119.6	121.3	
8½											
9				125.9	115.5	125.6	118.7	124.7	124.4	125.2	
9½											
10				131.1	124.6	129.4	126.7	130.1	129.0	130.8	131.8
10½											
11	128.3			134.9	128.9	130.6	130.4	134.9	134.0	135.9	136.7
11½											
12	134.1			141.8	133.6	146.7	135.7	141.7	141.1	142.4	143.5
12½											
13	143.7			148.3	137.4	147.6	143.1	147.1	146.5	148.3	149.1
13½											
14	153.0		147.8	152.9	148.3	155.9	149.5	150.4	151.8	154.1	153.7
14½		150.5									
15	157.8	148.5		156.5		155.5	153.5	156.5	156.4	156.6	156.5
15½											
16	166.6	151.8		157.6			149.8	158.5	158.0	159.3	158.0
16½		159.9	149.9								
17		158.4	151.9	159.1					160.3	160.6	159.8
17½		155.8	152.9					160.3			
18		156.5	154.2	159.5			155.4		160.8	160.3	158.8
18½		157.5	156.0								
19		158.9	156.7	159.8							
19½		160.3	158.5								
20		160.9	159.0	160.5							
20½		162.3	160.3								
21		165.5	161.3								
22		164.8	162.8								
23		165.7									
24											
27		168.5	170.2								
28		170.4									
31		173.0									
32			170.9								
		**	**								

HEIGHT OF FEMALES IN CENTIMETERS

Age in Years	American								
	26a Peckham[45]	27 Porter[46]	28 Porter[47]	29 Robertson[48]	30 Smedley[49]	33a Stiles and Wheeler[50]	33b Stiles and Wheeler[51]	34 West[52]	35 Young[53]
5								107.4	
5½									
6		107.7	107.1	115.1	109.7	114.9	114.9	111.3	110.2
6½					112.5				
7		113.0	113.0	121.2	115.4	118.9	118.9	117.6	116.3
7½					118.2				
8		118.4	118.4	126.5	120.5	123.2	124.0	121.6	124.8
8½					122.8				
9		123.7	123.7	130.6	125.3	126.5	127.9	126.6	129.8
9½					127.8				
10		128.5	128.4	137.7	130.1	131.9	132.2	132.8	133.6
10½					132.7				
11		133.1	133.2	141.0	135.4	137.1	138.0	137.0	140.9
11½					138.3				
12	142.0	139.2	139.1	147.3	141.3	143.8	143.9	144.7	146.6
12½					144.3				
13	143.5	146.6	146.5	155.2	147.7	152.3	152.8	147.9	147.3
13½					151.1				
14	150.1	150.6	150.8	158.5	153.6	153.1	152.7	153.7	155.6
14½					156.3				
15	156.5	154.9	155.0		156.9	156.7	156.9	157.0	160.9
15½					157.5				
16	161.3	157.5	157.5		158.3	158.5	158.8	158.5	159.2
16½					159.2				
17	162.1	159.3	159.3		159.3	159.4	159.5	159.5	158.9
17½					159.4				
18	162.1	159.5	159.4		159.4			159.0	155.9
18½					159.5				
19	162.1	158.5	158.5					159.3	
19½									
20			159.4					159.0	
20½									
21			160.0					159.3	
22									
23									
24									
25									
26									
27									
28									
29									
30									

HEIGHT OF FEMALES IN CENTIMETERS

	Canadian	Amer. & Engl.	English								
Age in Years	36 Boas[54]	37 Stephenson[55]	38 Berry[56]	39a Elderton[57]	39b Elderton[58]	40 Galton[59]	41 Galton[60]	42 Kerr[61]	44a Roberts[62]	45 Shuttleworth[63]	46 Stanway[64]
5	105.0	104.3				97.3	102.9		103.7	108.7	
5½											
6	110.3	109.2		104.1	108.5	103.1	108.7	119.0	108.3	112.9	
6½											
7	115.9	114.3		109.0	113.8	109.0	113.0	124.0	112.9	118.4	
7½											
8	120.5	119.6		113.3	117.9	113.0	118.4	129.0	118.4	123.8	
8½											
9	125.1	124.6		118.4	123.4	118.4	123.7	135.0	123.8	129.7	
9½											
10	130.7	130.0		123.2	128.0	123.7	129.5	141.0	131.7	134.9	125.7
10½											
11	135.9	135.3	139.7	127.8	132.6	129.8	134.9	147.0	134.9	141.4	131.3
11½											
12	141.6	141.7	144.8	133.1	137.4	134.9	141.2	156.0	141.1	146.7	136.1
12½											
13	148.1	147.2	147.3	138.2	143.5	144.0	146.6	162.0	146.7	151.9	141.2
13½											
14	152.8	152.1	156.2	141.7	149.1	146.8	151.9	166.0	151.9	154.8	147.1
14½											
15		155.0	157.5			151.9	154.7	167.0	154.8	156.9	149.1
15½											
16		156.6				154.7	156.7	168.0	156.9	158.8	151.1
16½											
17		158.0				156.7	158.8	168.0	158.8	158.6	154.2
17½											
18		158.0				158.8	158.5		158.6	159.4	
18½											
19						158.5	159.3		159.4	160.0	
19½											
20						159.5	159.8		160.0	160.1	
20½											
21						160.0	160.0		160.1	159.7	
22						160.0			159.7	160.1	
23									160.1	159.3	
24									159.3		
25											
28										157.5	

HEIGHT OF FEMALES IN CENTIMETERS

	English			Norwegian				Swedish		Danish	
Age in Years	49a Tuxford & Clegg[65]	49b Tuxford & Clegg[66]	49c Tuxford & Clegg[67]	50 Schiötz[68]	51a Schiötz[69]	51b Schiötz[70]	51c Schiötz[71]	52a Key[72]	52b Key[73]	53a Hertel[74]	53b Hertel[75]
5	102.6	103.1	102.0								
5½											
6	107.6	108.0	107.2		115.2			113.0		112.0	
6½											
7	113.9	114.6	113.4		117.8	121.1	119.5	116.0		115.0	
7½											
8	117.6	117.8	117.5		123.0	127.0	125.0	123.0		120.0	
8½									121.0		
9	123.7	125.6	122.6		127.4	132.4	128.3	127.0		125.0	
9½									125.0		
10	129.8	130.2	129.4		131.8	136.5	133.9	132.0		130.0	
10½									130.0		
11	133.5	135.6	132.3		136.4	140.2	138.2	137.0		133.0	
11½									134.0		135.0
12	138.7	138.5	139.3	147.2	142.7	148.2	144.6	143.0		138.0	
12½									140.0		141.0
13	144.5	145.1	144.0	150.3	148.2	153.8	139.6	148.0		146.0	
13½									146.0		149.0
14	149.0	149.8	148.7	157.5	151.7	158.1	156.1	153.0		151.0	
14½									151.0		154.0
15				159.7				157.0		154.0	
15½									154.0		
16				160.3				159.0		159.0	
16½											
17				161.1				160.0			
17½											
18								160.0			
18½											
19								162.0			
19½											
20								160.0			
20½											
21											
22											
23											
24											
25											
26											

HEIGHT OF FEMALES IN CENTIMETERS

	Bel.	Fr.	German								
Age in Years	55 Quetelet[76]	58 Variot & Chaumet[77]	59a Ascher[78]	59b Ascher[79]	63 Daffner[80]	64 Geissler[81]	65a Geissler und Uhlitzsch[82]	65b Geissler und Uhlitzsch[83]	66a Hasse[84]	66b Hasse[85]	70 Radosavljevich[86]
5	97.3										
5½		101.9									
6	103.1										111.4
6½		108.9	110.0	110.0		109.3	111.2	107.3			
7	108.7										116.6
7½		113.8	115.0	116.0		113.7	115.2	111.6			
8	114.2										121.4
8½		119.5	122.0	120.0		117.7	119.1	116.3	120.5	116.4	
9	119.6										127.0
9½		124.7	125.0	123.0		124.0	124.2	120.4	126.0	123.2	
10	124.9										131.0
10½		129.5	132.0	129.0		128.6	129.7	125.2	130.2	128.1	
11	130.1										135.9
11½		134.4	134.0	135.0		133.9	134.2	130.3	135.1	133.4	
12	135.2										141.1
12½		141.5	144.0	140.0		139.5	138.3	135.7	142.0	138.4	
13	140.0										148.5
13½		148.6	147.0	145.0		145.1	145.8	140.7	147.2	144.3	
14	144.6										154.1
14½		152.9							150.6	147.7	
15	148.8										160.0
15½		154.2									
16	152.2				150.1						
16½											
17	154.7				151.9						
17½											
18	156.2				153.9						
18½											
19	157.0				156.0						
19½											
20	157.5				157.5						
21					159.0						
22					160.5						
23					162.1						
24					164.1						
25					166.6						
26					168.4						

HEIGHT OF FEMALES IN CENTIMETERS

	German									Swiss	
Age in Years	71 Ranke[87]	72 Reuter[88]	73a Rietz[89]	73b Rietz[90]	74 Samosch[91]	76 Schmid-Monnard[92]	77a Schmidt[93]	77c Schmidt[94]	77b Schmidt[95]	80 Combe[96]	81 Ernst[97]
5	97.0					99.7					
5½											
6	107.3	110.0	118.8	111.7	108.0	110.8					
6½							108.5				
7	113.6	114.0	121.5	117.0	114.0	115.2				116.3	
7½							114.1				
8	116.5	124.0	127.2	121.7	118.0	119.8				121.2	
8½							118.5	117.8	119.1		123.7
9	123.3	127.0	131.0	125.0	124.0	124.7				125.7	
9½							123.9	123.2	124.4		125.0
10	127.3	131.0	135.7	130.6	128.0	128.8				131.1	
10½							129.2	128.0	130.1		133.6
11	131.8	134.0	141.2	135.7	134.0	134.5				136.4	
11½							133.6	133.3	133.7		137.1
12	136.9	140.0	147.8	140.8	138.0	139.4				142.0	
12½							138.7	138.0	139.2		140.0
13	141.1	144.0	152.1	148.1	145.0	145.4				147.1	
13½							144.2	143.0	145.0		148.4
14	146.2		156.6	150.5	148.0	151.8					
14½											150.3
15	147.5		157.7								
15½											
16											
16½											
17											
17½											
18											
18½											
19											
19½											
20											
20½											
21											
22											
23											
24											
25											

HEIGHT OF FEMALES IN CENTIMETERS

	Russian						Italian			Japanese	
Age in Years	86a Erismann[98]	86b Erismann[99]	87a Kosmowski[100]	89b Michailoff[101]	89a Michailoff[102]	94d Weissenberg[103]	96a Pagliani[104]	96c Pagliani[105]	96b Pagliani[106]	99a Misawa[107]	98 Misawa[108]
5						99.8	96.5			96.5	
5½											
6						106.6	102.1			102.4	
6½											
7	111.5					112.4	109.2			107.2	105.3
7½											
8	116.3	118.8				116.7	115.6			112.0	109.5
8½			116.6	116.4	117.6			111.8	120.2		
9	119.6	123.0				122.1	120.9			116.2	114.1
9½			120.2	119.6	121.6			118.0	124.8		
10	125.0	129.5				127.4	127.3			120.4	118.5
10½			125.2	125.0	125.1			124.2	130.6		
11	129.8	131.0				132.2	131.3			125.9	123.2
11½			130.2	129.7	128.5			130.0	133.5		
12	132.8	135.5				139.2	136.7			132.3	128.3
12½			135.1	132.9	133.1			135.2	139.4		
13	138.4	139.9				144.0	142.5			139.0	133.3
13½			138.4	138.3	137.8			138.3	146.4		
14	145.8	143.5				149.3	149.6			143.2	137.7
14½			144.0	145.8				144.5	152.1		
15		148.2				150.6	152.7			144.7	141.6
15½				146.4							
16		151.0				151.6	153.9				143.7
16½				150.3							
17		152.4				153.1	154.9				
17½											
18		152.8				154.0	154.9				
18½											
19		153.3				153.8					
20		153.0				153.7					
21		153.1				**					
22		153.3									
23		153.2									
24		153.5									
25		152.9									
26		153.1									
27		153.1									
28		153.1									
29		153.4									
30		**									

HEIGHT OF FEMALES IN CENTIMETERS

	Chinese		Philippine
Age in Years	102 Merrins[109]	103a Whyte[110]	104 Bobbitt[111]
5			
5½			
6			
6½			
7			114.5
7½			
8			117.5
8½			
9			123.2
9½			
10			127.3
10½			
11		130.0	128.3
11½			
12	132.6	133.8	134.8
12½			
13	139.7	139.5	142.5
13½			
14	145.3	141.0	145.5
14½			
15	147.3	147.3	148.0
15½			
16	149.9	147.3	148.8
16½			
17	150.4	146.5	150.0
17½			
18		150.7	149.0
18½			
19	152.4	151.3	149.6
19½			
20			148.6
20½			
21	153.7		
22			
23			
24			
25			
26			
27			
28			
29			
30			

III. SCHOOL CHILDREN AND ADULTS. HEIGHT OF FEMALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School, well-to-do class, F 706, consecutive measurements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School. Well-to-do class, F 100, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, F 60, consecutive measurements. Includes data of final norms page 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, F 47, consecutive measurements. Not discussed in previous sections of our *Study*.
5. Bib. 35, 1892, Oakland, M and F 4956.
6. Bib. 88, 1897, American, F 1967.
7. Bib. 88, 1897, American, F 43,298.
8. Bib. 88, 1897, Oakland, F 2377.
9. Bib. 80, 1891, half bloods and Indians of North Pacific Coast.
10. Bib. 95, 1911, American born Scotch, F 78.
11. Bib. 95, 1911, American born Bohemian, F 674.
12. Bib. 95, 1911, American born Hungarian and Slovak, F 112.
13. Bib. 95, 1911, American born Polish, F 85.
14. Bib. 95, 1911, American born Hebrew, F 552.
15. Bib. 95, 1911, American born Sicilian, F 270.
16. Bib. 95, 1911, American born Neopolitan, F 439.
17. Bib. 95, 1911, American born Italian, F 24.
18. Bib. 95, 1911, foreign born Scotch, F 39.
19. Bib. 95, 1911, foreign born Bohemian, F 160.
20. Bib. 95, 1911, foreign born Hungarian and Slovak, F 102.
21. Bib. 95, 1911, foreign born Polish, F 84.
22. Bib. 95, 1911, foreign born Hebrew, F 359.
23. Bib. 95, 1911, foreign born Sicilian, F 744.
24. Bib. 95, 1911, foreign born Neopolitan, F 339.
25. Bib. 109, 1875, Boston, F 10,904.
26. Bib. 110, 1879, Boston, laboring class. Taken from Ernst, Bib. 241.
27. Bib. 110, 1879, Boston, non-laboring class. Taken from Ernst Bib. 241.
28. Bib. 294, 1895, New Haven, F 584.
29. Bib. 295, 1897, Iowa, F 50.
30. Bib. 317, 1890, negroes, M and F 223.
31. Bib. 317, 1890, American white, M and F 724.
32. Bib. 317, 1890, negroes, M and F 574.
33. Bib. 317, 1890, Kansas City, white, M and F 2619.
34. Bib. 317, 1890, foreign descent, M and F 385.
35. Bib. 345, 1893, Oberlin College, F 500.
36. Bib. 345, 1893, Oberlin College, M and F 1600.
37. Bib. 356, 1902, Nebraska, F 7069.
38. Bib. 403, 1899, Italian descent.
39. Bib. 403, 1899, New York, negro asylum children.
40. Bib. 403, 1899, New York, white asylum children.
41. Bib. 490, 1897-98, Washington, D. C., F 8520.
42. Bib. 490, 1897-98, Washington, D. C., laboring class.
43. Bib. 490, 1897-98, Washington, D. C., non-laboring class.
44. Bib. 580, 1881, Milwaukee, F 4891.
45. Bib. 580, 1881.
46. Bib. 614, 1893, St. Louis, F 18,059.
47. Bib. 615, 1894, St. Louis, F 16,527.
48. Bib. 669a, 1916, Oakland.
49. Bib. 764, 1900, Chicago, F 3471.
50. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, F 881.

51. Bib. 782, 1915, southern states, homes of good sanitary condition, F 657.
52. Bib. 873, 1896, Worcester, M and F 3250.
53. Bib. 900, 1913 Chicago, favored class, F 144.
54. Bib. 95, 1911, Toronto.
55. Bib. 778, 1888.
56. Bib. 58, 1904, London, scholarship girls, F 1384.
57. Bib. 229, 1914, Glasgow, poorer class.
58. Bib. 229, 1914, Glasgow, better class.
59. Bib. 281, 1883, schools, military and naval colleges, M and F 29, 405.
60. Bib. 281, 1883, all classes.
61. Bib. 427, 1918.
62. Bib. 663, 1878, all classes, M and F 30,000.
63. Bib. 752, 1884, general population.
64. Bib. 773, 1833, Manchester.
65. Bib. 827, 1911, all England, F 258,834.
66. Bib. 827, 1911, county education areas, F 121,648.
67. Bib. 827, 1911, urban education areas, F 137,186.
68. Bib. 706, 1919, Kristiania, F 177.
69. Bib. 704, 1917, F 4204.
70. Bib. 704, 1917, Kristiania, better class, F 394.
71. Bib. 704, 1917, Kristiania, better class, Volksschule, F 426.
72. Bib. 431, 1889, F 3000.
73. Bib. 431, 1889, Volksschulen. Taken from Ernst, Bib. 241.
74. Bib. 368, 1882, F 11,250.
75. Bib. 368, 1882, höhere Schulen.
76. Bib. 628, 1836, F 10 at each age.
77. Bib. 838, 1906, Paris, poorer class.
78. Bib. 18, 1912, Hamm.
79. Bib. 18, 1912, Königsberg.
80. Bib. 190, 1884.
81. Bib. 291 and 292, 1888, Gohlis-Leipzig Bürgerschule, F 1420.
82. Bib. 291 and 292, 1888, Freiberg Bürgerschule, F 10,830.
83. Bib. 291 and 292, 1888, Freiberg mountaineers' children, Volksschulen.
84. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 1. Taken from Ernst, Bib. 241.
85. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 2. Taken from Ernst, Bib. 241.
86. Bib. 639, 1913, Mostar, Austria, F 615.
87. Bib. 645, 1905, Kiel and Lübeck, F 1000.
88. Bib. 653, 1903, Pommerania. Taken from Stratz, Bib. 793.
89. Bib. 657, 1903, Berlin, Gymnasium, F 533.
90. Bib. 657, 1903, Berlin, Volksschulen, F 1365.
91. Bib. 687, 1904, Breslau. Taken from Stratz, Bib. 793.
92. Bib. 723, 1901, Halle, F 906.
93. Bib. 724, 1892, Saalfeld, Bürgerschulen.
94. Bib. 724, 1892, Saalfeld, city children. Taken from Ernst, Bib. 241.
95. Bib. 724, 1892, Saalfeld, country children. Taken from Ernst, Bib. 241.
96. Bib. 175, 1896, Lausanne, M and F 2000.
97. Bib. 241, 1906, Zürich, Volksschulen, F 175.
98. Bib. 238 and 239, 1888, Moscow, F 1495.
99. Bib. 238 and 239, 1888, Central Russia, laboring class, F 29,351.
100. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
101. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
102. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
103. Bib. 865, 1911, South Russian Jews, F 1438.
104. Bib. 573 and 574, 1875-79, Turin, F 968.

105. Bib. 573 and 574, 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
106. Bib. 573 and 574, 1875-79, Turin, favored class. Taken from Ernst, Bib. 241.
107. Bib. 528, 1909.
108. Bib. 528, 1909.
109. Bib. 519, 1910, students, F 69.
110. Bib. 876, 1918, southern provinces, F 613.
111. Bib. 103, 1909, F 438.

WEIGHT OF MALES IN KILOGRAMS

	American										
Age in Years	1a Baldwin[1]	1b Baldwin[2]	2a Baldwin[3]	2b Baldwin[4]	3 Barnes[5]	4 Beyer[6]	6 Boas[7]	5a Boas[8]	8b Boas[9]	8c Boas[10]	8e Boas[11]
5	17.3		19.0								
5½	18.6		18.9								
6	19.5	21.3	20.5		21.6		21.6	20.7			
6½	20.3	23.1	21.8								
7	21.3	22.5	23.0	24.3	22.8		23.5	22.6			
7½	23.3	25.5	23.2	25.5							
8	24.6	25.9	25.3	26.9	24.6		26.0	24.5			25.4
8½	25.4	27.2	25.4	27.3							
9	27.4	26.6	27.6	28.1	27.0		28.2	26.9	27.2	24.3	26.0
9½	28.2	28.4	29.2	30.6							
10	30.4	30.5	30.9	30.7	30.3		31.3	29.8	28.6	30.5	27.9
10½	32.4	31.2	32.1	32.4							
11	33.3	32.3	33.7	34.1	32.7		33.9	32.3	31.6	31.0	30.8
11½	34.3	33.0	35.4	36.3							
12	36.7	34.8	35.0	37.3	35.3		37.0	35.6	33.3	32.9	33.1
12½	38.4	35.3	39.2	38.8							
13	40.6	39.0	40.1	41.7	40.6		40.4	39.4	38.3	37.0	37.1
13½	39.8	39.5	44.0	45.3							
14	43.1	43.6	44.7	47.4	44.0		47.7	44.5	41.1	38.0	42.3
14½	44.9	46.5	47.8	50.1							
15	47.6	48.8	49.4	53.3	49.0	48.5	54.2	51.6	42.7	42.7	44.6
15½	52.6	49.2	54.9	56.7							
16	53.9	50.8	54.3	58.1	55.2	53.5		55.6	37.0		49.1
16½	57.7	51.9	59.9	61.7							
17	58.3	56.6	56.6	63.1	59.7	56.7		60.2			
17½	57.6	58.3	60.4	63.6							
18	58.5	59.2	61.6	65.1	62.5	60.5					
18½			58.5	64.1							
19						63.4					
19½											
20						64.1					
20½											
21						63.5					
22						64.1					
23						65.3					
24											
25											
26											
27											
28											
29											

WEIGHT OF MALES IN KILOGRAMS

	American										
Age in Years	8f Boas[12]	8g Boas[13]	8j Boas[14]	8k Boas[15]	8m Boas[16]	8n Boas[17]	8o Boas[18]	9 Bowditch[19]	10 Bowditch[20]	11a Bowditch[21]	11b Bowditch[22]
5								18.7			
5½											
6								20.5			
6½											
7								22.3			
7½											
8						23.0		24.5			
8½										24.3	24.8
9	27.0	26.9	27.0	31.0		33.0	27.0	26.9			
9½										26.9	27.2
10	27.3	27.1	30.5	26.8	27.4	30.0	26.8	29.6	32.0		
10½										29.6	30.1
11	30.1	30.6	30.1	31.1	30.8	29.8	31.6	31.8	34.2		
11½										31.6	32.6
12	32.3	32.7	34.9	32.0	32.3	33.3	33.0	34.9	39.0		
12½										34.4	36.5
13	35.8	36.1	41.1	36.2	35.9	35.8	35.5	38.5	42.8		
13½										37.8	40.2
14	40.5	39.5	41.9	39.2	41.4	39.4	39.2	43.1	45.3		
14½										42.5	43.8
15	41.4	42.0	44.0		44.6	42.9	42.9	48.6	52.9		
15½										47.6	49.3
16	56.0	47.8			50.4	40.0	52.6	54.9	57.1		
16½											
17		41.0					55.5	57.8	61.3		
17½											
18								60.1	62.7		
18½											
19											
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											
29											

WEIGHT OF MALES IN KILOGRAMS

	American										
Age in Years	12 Cordeiro[23]	13 Gilbert[24]	14 Gilbert[25]	15a Greenwood[26]	15b Greenwood[27]	16c Greenwood[28]	16a Greenwood[29]	17 Hall[30]	19a Hastings[31]	19b Hastings[32]	20 Hastings[33]
5											17.8
5½											
6		21.2	20.8								19.3
6½											
7		23.2	23.3								21.3
7½											
8		23.8	25.0								23.1
8½											
9		27.2	27.9					26.5			25.0
9½											
10		31.0	28.9					30.0			27.8
10½											
11		32.1	32.8	30.1	31.2	30.6		32.5			29.8
11½											
12		37.3	35.5	33.2	32.4	32.2	34.8	36.5			32.9
12½											
13		39.9	41.2	36.9	39.7	35.5	35.2	40.7			35.5
13½											
14	39.1	41.6	46.3	39.6	41.9	39.7	41.5	45.2			39.6
14½											
15	43.7	49.9	53.1	41.8	44.6	42.4	48.1	49.3			46.9
15½											
16	49.7	57.6	59.0	48.7	49.8	50.5	48.5	57.0			52.8
16½											
17	54.5	59.0	63.6			54.0		60.7	59.8	59.9	56.7
17½											
18			64.7			57.4		62.9	60.4	60.8	59.1
19			66.0			62.1		63.8	61.4	61.6	61.6
20								64.7	62.7	62.7	61.0
21								65.8	63.3	63.5	
22									63.9	64.0	
23									63.8	64.1	
24									64.5	64.6	
25									65.8	65.8	
26									65.4	65.7	
27									65.3	65.5	
28									64.0	63.8	
29									64.7	64.7	
30									66.5	66.5	

WEIGHT OF MALES IN KILOGRAMS

	American										
Age in Years	21 Hastings[34]	23a Hrdlička[35]	23d Hrdlička[36]	24a Macdonald[37]	25 Peckham[38]	27 Porter[39]	28 Porter[40]	29 Robertson[41]	30 Smedley[42]	33a Stiles and Wheeler[43]	33b Stiles and Wheeler[44]
5	17.8		15.0	20.5	18.7						
5½											
6	19.3	17.6	18.1	21.7	20.3	19.8	19.8	20.9	19.7	20.2	19.7
6½									20.7		
7	21.3	20.3	20.4	23.4	22.3.	21.7	21.7	23.0	21.6	22.8	22.7
7½									22.6		
8	23.1	21.0	21.3	25.5	24.4	23.8	23.8	25.1	23.8	24.6	24.7
8½									25.1		
9	25.0	24.0	24.0	27.9	27.0	26.1	26.1	29.0	26.3	26.2	26.1
9½									27.6		
10	27.8	25.5	25.9	30.0	29.7	28.3	28.3	30.4	28.7	29.2	29.5
10½									29.8		
11	29.4	28.0	29.0	33.0	32.2	31.0	31.0	34.4	31.2	31.5	31.6
11½									32.6		
12	32.9	31.3	31.8	36.0	34.5	33.5	33.5	36.9	34.2	36.1	35.3
12½									35.7		
13	35.5	32.7	36.7	40.1	38.5	36.6	36.6	42.0	38.1	39.6	39.0
13½									40.5		
14	39.7	38.6	38.1	45.8	43.5	40.4	40.5	47.0	42.7	42.4	42.0
14½									44.9		
15	46.9	34.5	38.6	51.6	49.4	46.2	46.2		48.0	49.5	50.1
15½									51.1		
16	52.8		52.2	55.0	55.4	51.6	51.6		53.3	49.6	50.1
16½									55.4		
17			55.3	59.9	59.2	55.7	55.7		57.4	57.4	56.8
17½									59.4		
18				60.0	62.5		55.9		61.3		
18½									63.2		
19											
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											
29											

WEIGHT OF MALES IN KILOGRAMS

	American		Am&En	English						
Age in Years	34 West[45]	35 Young[46]	37 Stephenson[47]	39a Elderton[48]	39b Elderton[49]	40 Galton[50]	41 Galton[51]	42 Kerr[52]	43 Maclaren[53]	44a Roberts[54]
5	19.3		18.4				18.1			18.1
5½										
6	20.9	22.0	20.3	18.6	19.6		20.1	21.5		20.1
6½										
7	22.4	24.5	22.4	20.1	21.1		22.6	24.1		22.6
7½										
8	24.3	26.9	24.7	21.8	23.2		24.9	26.6		24.9
8½										
9	27.1	30.3	27.1	23.7	25.5		27.4	29.1		27.4
9½										
10	30.2	30.9	30.1	25.7	27.8	33.6	30.6	32.0	29.5	30.6
10½										
11	32.2	33.6	32.2	27.9	30.1	35.7	32.7	35.1	31.8	32.7
11½										
12	35.7	40.0	34.8	30.1	32.1	38.5	34.8	38.4	35.5	34.8
12½										
13	39.1	48.1	38.0	32.5	34.9	41.5	37.2	42.0	38.1	37.5
13½										
14	44.5	47.6	42.4	34.3	37.7	46.3	41.7	46.1	42.2	41.7
14½										
15	50.9	36.8	47.6			51.9	46.6	51.1	47.0	46.6
15½										
16	56.1	43.7	54.4			58.7	54.0	56.0	52.9	54.0
17	60.3		58.6			64.3	59.0	59.3	58.3	59.4
18	60.4		61.2			66.4	62.3		62.1	62.3
19	64.7					67.3	63.3			63.3
20						69.1	65.0			65.0
21						69.3	65.9			65.9
22						69.3				66.6
23										67.0
24										67.1
25										67.7
26										68.8
27										69.1
28										69.8
29										69.9
30										72.5
31										
32										
33										
34										

WEIGHT OF MALES IN KILOGRAMS

	English										
Age in Years	44b Roberts[55]	44c Roberts[56]	44d Roberts[57]	44e Roberts[58]	44f Roberts[59]	44h Roberts[60]	44g Roberts[61]	45 Shuttleworth[62]	47a Stephenson[63]	47b Stephenson[64]	48 Thorne[65]
5	16.9	22.7									
5½											
6	18.4	24.6									
6½											
7	20.6	25.8				24.9					
7½											
8	22.1	26.8				27.2		25.0			
8½				25.0							
9	24.3	28.4				28.1		27.2			25.4
9½				26.6							
10	25.6	30.1	30.6			30.1		29.5	29.9	30.4	31.8
10½				28.2	28.8						
11	26.9	31.5	33.1			31.6	30.1	31.8	31.8	33.1	32.9
11½				29.5	31.1						
12	28.6	33.4	36.4			34.1	31.5	35.2	33.6	36.3	34.7
12½				31.3	34.3						
13	32.1	35.5	40.2			37.2	33.4	38.6	35.4	39.9	38.1
13½				33.2	37.8						
14	36.6	38.4	45.0			41.8	35.5	42.0	38.1	44.5	44.5
14½				35.9	42.3						
15	43.5	43.9	50.1			47.8	37.0	46.5	42.6	49.9	50.8
15½				41.1	47.1						
16	50.3	49.3	58.2			53.9	43.9	53.3	48.1	57.2	50.8
16½				46.2	54.7						
17	56.3	52.8	64.0			57.8	49.3	61.2	52.6	63.5	
17½											
18	58.7	55.9	66.2			63.5	52.8	64.6	55.3	66.2	
18½											
19	60.6	58.2	67.3			64.0	55.9	65.2	58.1	67.1	
19½											
20	61.9	59.2	69.0				58.2	65.8	59.9	68.0	
20½											
21	62.6		69.1				59.2	66.3	61.7	69.0	
22	63.1		70.2					66.9			
23											
24											
25											
27	64.0										
28								67.5			

WEIGHT OF MALES IN KILOGRAMS

	English			Norwegian	Swedish		Danish		Belgian	French	
Age in Years	49a Tuxford and Glegg[66]	49b Tuxford and Glegg[67]	49c Tuxford and Glegg[68]	50 Schiötz[69]	52a Key[70]	52b Key[71]	53a Hertel[72]	53b Hertel[73]	55 Quetelet[74]	57 Godin[75]	58 Variot and Chaumet[76]
5	17.5	17.7	17.3						15.9		
5½											15.9
6	19.3	19.4	19.3		20.5				17.8		
6½						21.8	21.0				17.5
7	21.2	21.8	21.0		22.8				19.7		
7½						22.5	22.5				19.0
8	22.9	23.3	22.8		26.2				21.6		
8½						25.8	24.0				21.1
9	25.1	25.9	24.7		29.3				23.5		
9½						26.3	26.0				23.8
10	27.4	27.8	27.2		30.3				25.2		
10½						28.7	28.5				25.6
11	29.9	30.8	29.5		32.2				27.0		
11½						33.6	31.0	33.0			27.7
12	33.1	33.3	32.5	35.0	34.5				29.0		
12½						33.0	33.5	35.0			30.1
13	35.2	35.3	35.0	37.6	37.6				33.1		
13½						36.0	36.5	37.5		37.5	35.7
14	38.2	38.3	38.1	42.6	42.3				37.1	39.3	
14½						37.0	40.5	41.5		41.9	41.9
15				50.0	46.8				41.2	44.1	
15½						44.3	46.5	46.5		47.2	47.5
16				54.3	52.3				45.4	50.3	
16½							53.0	53.0		53.0	
17				59.5	57.6				49.7	54.8	
17½							57.5			56.5	
18					61.3				53.9		
18½							61.0				
19					63.3				57.6		
19½											
20					65.2				59.5		
20½											
21											
22											
23											

WEIGHT OF MALES IN KILOGRAMS

	German									
Age in Years	59b Ascher[77]	59a Ascher[78]	60 Camerer[79]	62 Daffner[80]	64 Geissler[81]	66b Hasse[82]	66a Hasse[83]	67 Kotelmann[84]	69b Peiper[85]	69c Peiper[86]
5			19.3							
5½										
6			21.1		21.4					
6½	20.2	19.8							18.9	19.1
7			23.0		22.9					
7½	21.8	21.8							20.5	21.1
8			24.9		24.7					
8½	23.7	24.0				24.3	25.2	26.9	22.6	23.7
9			26.8		26.7					
9½	26.0	26.0				26.1	27.9	28.3	24.6	25.1
10			29.4		28.8					
10½	28.0	27.4				28.2	28.5	30.7	26.8	27.3
11			32.1		32.0					
11½	31.1	30.7				30.6	31.6	33.9	29.6	29.9
12			34.9		34.6					
12½	33.8	34.4				34.2	35.3	35.8	32.3	32.4
13			38.2	34.5	36.0					
13½	36.7	37.1				35.7	36.4	41.0	35.3	35.5
14			42.6	38.1						
14½						38.8	41.1	45.9		
15			51.0	43.6						
15½								51.9		
16			57.1	45.5						
16½										
17			62.7	48.5						
17½										
18			66.0	56.5						
18½										
19				55.6						
19½										
20				57.0						
20½										
21				57.2						
22				66.2						
23										
24										
25										
26										
27										
28										

WEIGHT OF MALES IN KILOGRAMS

	German										
Age in Years	69a Peiper[87]	70 Radosavljevich[88]	73b Rietz[89]	73c Rietz[90]	73a Rietz[91]	75a Schlesinger[92]	75b Schlesinger[93]	75c Schlesinger[94]	75d Schlesinger[95]	75e Schlesinger[96]	75f Schlesinger[97]
5											
5½											
6		19.8	20.1		22.5	18.9	18.2	15.5	22.9	18.5	17.1
6½	19.0										
7		21.0	21.6		24.3	22.4	18.9		23.9	20.1	18.3
7½	20.9										
8		23.9	23.3		26.0	24.1	20.4	18.5	26.3	21.5	19.8
8½	22.9			26.2							
9		26.9	25.7		27.7	26.5	22.6	19.2	29.6	24.0	21.6
9½	25.0			27.8							
10		28.9	27.6		32.0	29.1	24.1	20.1	30.9	26.0	22.6
10½	27.0			30.6							
11		31.9	29.9		34.3	30.3	25.8	22.4	33.9	26.4	23.7
11½	29.6			33.1							
12		34.0	32.8		40.4	35.5	29.1	25.4	37.5	29.7	25.7
12½	32.4			37.1							
13		37.9	36.4		43.0	39.2	31.9	29.7	42.8	33.1	29.4
13½	35.4			41.6							
14		43.2	37.4		50.0	45.0	36.5	31.6	47.0	36.0	30.3
14½				46.0							
15		48.2			51.1	49.2	38.5	33.5	53.4	41.5	36.6
15½				51.7							
16		54.0				55.1	42.4	38.4	58.3	47.2	41.2
16½				56.3							
17		57.8							62.9	52.8	48.4
17½											
18		62.0							65.6	55.7	
18½											
19		62.9							69.0	57.9	53.2
19½											
20		62.9							69.0	57.0	
20½											
21											
22											
23											
24											
25											
26											
27											

WEIGHT OF MALES IN KILOGRAMS

	German		Polish	Swiss		Russian					
Age in Years	76 Schmid-Monnard[98]	77a Schmidt[99]	79 Suligowski[100]	82 Ernst[101]	81 Ernst[102]	84 Dementiew[103]	85c Diek[104]	86b Erismann[105]	86a Erismann[106]	87b Kosmowski[107]	87a Kosmowski[108]
5	16.1										
5½											
6	18.4	19.0							20.0		
6½											
7	19.8	21.2							22.0		
7½										22.4	
8	21.5	23.2							24.1		
8½			25.1		24.7					22.6	22.6
9	23.5	25.3		22.5					27.7		
9½			28.0		25.3					23.8	23.8
10	25.7	26.6		22.5		28.0		27.6	30.5		
10½			30.8		27.3		28.7			26.0	26.0
11	27.8	29.8		23.4		29.4		29.1	33.3		
11½			33.3		30.0		30.4			28.3	28.3
12	30.5	32.2		24.0		31.1		30.9	37.6		
12½			37.2		32.3		32.6			31.0	31.0
13	33.6	35.0		24.8		32.5		32.7	41.5		
13½			41.7		36.2		37.7			32.0	32.0
14	38.0	36.2		25.7		35.7		35.2	46.6		
14½			47.0		37.7		41.0			36.6	36.0
15				26.0		39.9		39.4	53.0		
15½			51.0				47.2				
16						44.5		44.0	57.4		
16½			56.0				52.6				
17						49.9		49.8	60.1		
17½			57.5				55.6				
18						64.6		53.9			
18½			57.7								
19						56.5		56.0			
19½			59.3								
20											
20½			62.1								
21											

WEIGHT OF MALES IN KILOGRAMS

	Russian										
Age in Years	88 Makower[109]	89a Michailoff[110]	89b Michailoff[111]	90c Mouratow[112]	91 Sack[113]	92a Spielrein[114]	92b Spielrein[115]	93 Starkow[116]	94a Weissenberg[117]	94b Weissenberg[118]	94c Weissenberg[119]
5											
5½											
6							20.2				
6½											
7						23.0	21.6				
7½											
8	26.0					24.5	24.0				
8½		22.2	22.0		23.6						
9	27.3					25.7	24.4				
9½		23.4	24.1		26.7						
10	30.2					28.0	27.7	29.8	26.0	25.7	26.2
10½		25.9	27.7	28.7	28.7						
11	32.5					29.8	29.9	32.8	27.0	27.3	27.3
11½		28.3	30.5	29.1	31.1						
12	36.2					31.9	34.8	35.2	29.0	30.8	32.0
12½		29.8	33.3	32.8	34.0						
13	41.2					36.4	34.8	39.5	32.2	33.3	34.7
13½		31.6	37.6	31.6	37.5						
14	43.9					37.7	38.3	44.5			
14½			41.5	35.3	43.9						
15	50.6						42.1	50.9			
15½			46.6	32.8	49.2						
16	54.4							56.1			
16½			53.0	37.8	53.7						
17	56.4							58.7			
17½				48.1							
18	56.9							59.4			
18½				51.1							
19	57.2							62.5			
19½				57.0							
20	57.7										
20½				53.2							
21	58.2										
22											
23											
24											
25											
26								64.3			
27											
28											

WEIGHT OF MALES IN KILOGRAMS

	Russian		Italian				Japanese			
Age in Years	94d Weissenberg[120]	95 Wiazemsky[121]	96a Pagliani[122]	96c Pagliani[123]	96b Pagliani[124]	97 Vitale-Vitali[125]	98 Misawa[126]	99a Misawa[127]	99b Misawa[128]	100 Miwa[129]
5	16.2		15.2					15.2		16.4
5½										
6	19.2		16.7					16.5		17.2
6½										
7	20.0		19.4				17.6	17.8		19.0
7½										
8	22.1		20.7				19.1	19.1		20.3
8½	-			22.7	20.5					
9	24.5		22.4				21.1	21.0		22.4
9½				25.7	21.8					
10	25.7	28.1	24.8				22.8	23.0		23.9
10½				27.5	24.4	24.3				
11	27.3	31.4	26.6				25.0	25.0		25.9
11½				30.7	26.0	26.5				
12	30.8	32.1	29.3				27.0	27.2		28.2
12½				30.0	28.0	27.6				
13	33.3	35.5	33.0				29.4	29.8	37.8	32.7
13½				35.5	31.5	30.0				
14	37.9	40.2	36.6				32.5	33.6	42.1	37.8
14½				41.7	32.3	32.6				
15	41.0	45.0	41.8				35.2	38.7	47.4	45.0
15½			.	46.4	39.5	34.1				
16	46.3	51.3	47.2				38.2		51.0	45.4
16½						36.1				
17	51.4	55.6	52.7						52.3	49.7
17½						39.1				
18	54.0	58.0	53.8							49.1
18½						38.1				
19	56.8	59.5	55.0							50.9
19½						39.7				
20	56.6									50.8
20½										
21										51.0
22										
23										
24										
26		59.8								

WEIGHT OF MALES IN KILOGRAMS

	Chinese				Philippine
Age in Years	101 Bobbitt[130]	102 Merrins[131]	103b Whyte[132]	103a Whyte[133]	104 Bobbitt[134]
5					
5½					
6					18.0
6½					
7					18.8
7½					
8					20.3
8½					
9	24.7				21.3
9½					
10	25.2				23.0
10½					
11	27.0	24.4		24.2	25.8
11½					
12	30.4	28.1	29.5	26.4	28.4
12½					
13	33.6	31.6	35.8	29.0	31.1
13½					
14	35.1	37.0	37.3	30.4	35.1
14½					
15	45.3	43.1	42.5	34.4	41.4
15½					
16		48.3	45.0	39.9	45.5
16½					
17		49.1	46.5	43.1	46.6
17½					
18		50.8	49.5	45.9	48.9
18½					
19		50.5	52.0	48.3	51.2
19½					
20		53.2			51.6
20½					
21		54.3			51.3
22		54.3			
23					
24					
25					
26					
27					
28					

III. SCHOOL CHILDREN AND ADULTS. WEIGHT OF MALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School, well-to-do class, M 100, consecutive measurements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School, well-to-do class, M 460, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, M 60, consecutive measurements. Includes data of final norms p. 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class. M 35, consecutive measurements. Not discussed in previous sections of our *Study*.
5. Bib. 35, 1892, Oakland, M and F 4956.
6. Bib. 63, 1895, U. S. naval cadets, M 4567.
7. Bib. 88, 1897, Oakland, M 1903.
8. Bib. 88, 1897, American, M 2109.
9. Bib. 95, 1911, American born Bohemian, M 523.
10. Bib. 95, 1911, American born Hungarian and Slovak, M 45.
11. Bib. 95, 1911, American born Hebrew, M 1831.
12. Bib. 95, 1911, American born Sicilian, M 153.
13. Bib. 95, 1911, American born Neopolitan, M 391.
14. Bib. 95, 1911, foreign born Bohemian, M 66.
15. Bib. 95, 1911, foreign born Hungarian and Slovak, M 34.
16. Bib. 95, 1911, foreign born Hebrew, M 533.
17. Bib. 95, 1911, foreign born Sicilian, M 204.
18. Bib. 95, 1911, foreign born Neopolitan, M 178.
19. Bib. 109, 1875, Boston, M 13,691.
20. Bib. 110, 1879, foreign.
21. Bib. 110, 1879, Boston laboring class. Taken from Ernst, Bib. 241.
22. Bib. 110, 1879, Boston non-laboring class. Taken from Ernst, Bib. 241.
23. Bib. 177, 1887, U. S. navy, M 4812.
24. Bib. 294, 1895, New Haven, M 50.
25. Bib. 295, 1897, Iowa, M 50.
26. Bib. 317, 1890, American, white, M and F.
27. Bib. 317, 1890, American negroes, M and F.
28. Bib. 317, 1890, Kansas City, white, M and F.
29. Bib. 317, 1890, foreign, M and F.
30. Bib. 341, 1895, Pennsylvania, M 2434.
31. Bib. 356, 1902, Amherst College, M 1321.
32. Bib. 356, 1902, Amherst College, M 2106.
33. Bib. 356, 1902, Nebraska, M 7700.
34. Bib. 356, 1902, American, M 5476.
35. Bib. 403, 1899, Italian descent.
36. Bib. 403, 1899, New York, white and negro asylum children.
37. Bib. 490, 1897-98, Washington, D. C., M 7953.
38. Bib. 580, 1881, Milwaukee, M 4773.
39. Bib. 614, 1893, St. Louis, M 16,295.
40. Bib. 615, 1894, St. Louis, M 15,325.
41. Bib. 669a, 1916, Oakland.
42. Bib. 764, 1900, Chicago, M 2788.
43. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, M 768.
44. Bib. 782, 1915, southern states, homes of good sanitary condition, M 593.
45. Bib. 873, 1896, Worcester, M and F.
46. Bib. 900, 1913, Chicago, favored class, M 218.
47. Bib. 778, 1888.
48. Bib. 229, 1914, Glasgow, poorer class.
49. Bib. 229, 1914, Glasgow, better class.

50. Bib. 281, 1883, public schools, military and naval college, M 29,405.
51. Bib. 281, 1883, all classes.
52. Bib. 427, 1918.
53. Bib. 495, 1895.
54. Bib. 663, 1878, all classes.
55. Bib. 663, 1878, soldiers, policemen, etc., M 29,531.
56. Bib. 663, 1878, artisan class, M 13,931.
57. Bib. 663, 1878, favored class, M 7709.
58. Bib. 663, 1878, Volksschulen. Taken from Ernst, Bib. 241.
59. Bib. 663, 1878, höhere Schulen. Taken from Ernst, Bib. 241.
60. Bib. 663, 1878, towns, M 2568.
61. Bib. 663, 1878, towns, M 7855.
62. Bib. 752, 1884, general population.
63. Bib. 778, 1888, laboring class.
64. Bib. 778, 1888, non-laboring class.
65. Bib. 819, 1904, London scholarship boys, M 1710.
66. Bib. 827, 1911, all England, M 261,531.
67. Bib. 827, 1911, county education areas, M 120,237.
68. Bib. 827, 1911, urban education areas, M 141,294.
69. Bib. 706, 1919, M 231.
70. Bib. 431, 1889, M 15,000.
71. Bib. 431, 1889, Volksschulen.
72. Bib. 368, 1882, Volksschulen, M 17,134.
73. Bib. 368, 1882, höhere Schulen. Taken from Ernst, Bib. 241.
74. Bib. 628, 1836, M 10 at each age.
75. Bib. 299, 1903.
76. Bib. 838, 1906, Paris, poorer class.
77. Bib. 18, 1912, Königsberg.
78. Bib. 18, 1912, Hamm.
79. 1911. Copied from Heubner,Bib. 375.
80. Bib. 191, 1884, M 700.
81. Bib. 291 and 292, 1888, Gohlis-Leipzig, Bürgerschule, M 1386.
82. Bib. 353, 1891, Gohlis-Leipzig, Bürgerschule 2. Taken from Ernst, Bib. 241.
83. Bib. 353, 1891, Gohlis-Leipzig, Bürgerschule 1. Taken from Ernst, Bib. 241.
84. Bib. 449, 1879, Hamburg, Gelehrtenschule. Taken from Ernst, Bib. 241.
85. Bib. 583, 1912, Pommerania, Volksschulen, city, M 14,194.
86. Bib. 583, 1912, Pommeraina, Volksschulen, country, M 28,334.
87. Bib. 583, 1912, Pommerania, Volksschulen, city and country combined, M 42,528.
88. Bib. 639, 1913, Mostar, Austria, M 545.
89. Bib. 657, 1903, Berlin, Volksschulen, M 1496.
90. Bib. 657, 1903, Berlin höhere Schulen. Taken from Ernst, Bib, 241.
91. Bib. 657, 1903, Berlin, Gymnasium, M 1740.
92. Bib. 714, 1917, poorer class, good. development.
93. Bib. 714, 1917, poorer class, medium development.
94. Bib. 714, 1917, poorer class, poor development.
95. Bib. 714, 1917, well-to-do class, good development.
96. Bib. 714, 1917, well-to-do class, medium development.
97. Bib. 714, 1917, well-to-do class, poor development.
98. Bib. 723, 1901, Halle.
99. Bib. 724, 1892, Saalfeld, Bürgerschulen, M 4699.
100. Bib. 796, 1887, Radom, M 1133.
101. Bib. 241, 1906.
102. Bib. 241, 1906, Zürich, Volksschulen, M 175.
103. Bib. 204, 1889, Moscow, factory workmen. Taken from Wiazemsky, Bib. 878.

104. Bib. 210, 1883, Gymnasium. Taken from Wiazemsky, Bib. 878.
105. Bib. 238 and 239, 1888, Central Russia, M 1048.
106. Bib. 238 and 239, 1888, Moscow, M 2453.
107. Bib. 448, 1894, Warsaw, M 1540.
108. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
109. Bib. 496, 1914, Wilna, Jewish children.
110. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
111. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
112. Before 1907, cigarette makers. Taken from Wiazemsky, Bib 878.
113. Bib. 683, 1893, Gymnasium.
114. Bib. 768, 1916, Rostow, in school, M 496.
115. Bib. 768, 1916, Rostow, not in school, M 304.
116. Bib. 774, 1897, cadets. Copied from Wiazemsky, Bib. 878.
117. Bib. 865, 1911, poorer class.
118. Bib. 865, 1911, middle class.
119. Bib. 865, 1911, wealthy class.
120. Bib. 865, 1911, South Russian Jews, M 768.
121. Bib. 878, 1907, St. Petersburg cadets, M 1908.
122. Bib. 573 and 574, 1875-79, Turin, M 1048.
123. Bib. 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
124. Bib. 573 and 574, 1875-79, Turin, well-to-do class. Taken from Ernst, Bib. 241.
125. Before 1907. Taken from Wiazemsky, Bib. 878.
126. Bib. 528, 1909, M and F 869,014.
127. Bib. 528, 1909, M 9606.
128. Bib. 528, 1909.
129. Bib. 529, 1893, M 1250.
130. Bib. 103, 1909, M 60.
131. Bib. 519, 1910, students, M 219.
132. Bib. 876, 1918, Pekin, M 1502.
133. Bib. 876, 1918, southern provinces, M 1357.
134. Bib. 103, 1909, M 1180.

WEIGHT OF FEMALES IN KILOGRAMS

	American										
Age in Years	1b Baldwin[1]	1a Baldwin[2]	2a Baldwin[3]	2b Baldwin[4]	3 Barnes[5]	5a Boas[6]	6 Boas[7]	9 Bowditch[8]	11a Bowditch[9]	11b Bowditch[10]	14 Gilbert[11]
5		17.2	17.2					18.0			
5½		18.2	18.5								
6	19.8	18.9	19.3		20.8	19.9	20.7	19.6			18.9
6½	21.2	20.1	20.8								
7	21.9	21.8	21.3	22.7	21.8	21.7	22.5	21.6			21.5
7½	22.2	22.9	23.2	24.2							
8	23.3	24.8	24.4	23.7	23.7	23.5	25.3	23.6			23.1
8½	25.2	25.9	26.0	24.4					23.5	23.9	
9	26.4	26.1	26.8	26.5	26.6	26.3	27.2	25.9			26.4
9½	26.9	27.9	29.2	28.4					25.7	26.7	
10	29.7	29.4	30.0	30.2	28.7	29.1	30.3	28.3			28.2
10½	29.8	31.0	32.7	31.8					28.1	28.9	
11	30.3	32.5	33.2	33.8	31.6	31.8	33.7	31.2			31.4
11½	32.9	34.0	36.9	35.8					30.8	32.0	
12	34.2	37.6	38.1	38.6	35.8	36.7	38.2	35.5			36.2
12½	37.7	41.5	42.4	41.5					35.2	36.4	
13	43.0	41.6	44.5	44.5	41.1	40.7	42.7	40.2			42.7
13½	43.1	43.7	47.6	46.9					39.7	41.4	
14	46.5	46.4	49.1	49.1	44.5	45.6	48.0	44.6			45.3
14½	47.0	48.0	51.7	50.9					44.4	45.1	
15	50.8	50.0	51.5	52.7	49.4	48.2	50.2	48.1			50.5
15½	50.4	52.3	52.7	53.9					47.7	48.8	
16	49.4	51.5	54.0	56.1	49.8	49.3	52.9	50.8			50.6
16½	51.0	53.0	54.6	56.5						50.4	
17	51.4	53.5	54.7	56.8	53.4	52.0	53.3	52.4			54.9
17½	52.9	54.0	56.0	56.4							
18	52.5	53.1	54.2	56.6	53.7			52.3			56.9
18½			55.4	57.4							
19											57.3
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											
29											

WEIGHT OF FEMALES IN KILOGRAMS

	American									
Age in Years	13 Gilbert[12]	15a Greenwood[13]	15b Greenwood[14]	16c Greenwood[15]	16a Greenwood[16]	18a Hanna[17]	18b Hanna[18]	20 Hastings[19]	23a Hrdlička[20]	23d Hrdlička[21]
5								17.3		15.4
5½										
6	20.1							18.5	17.7	18.1
6½										
7	22.9							20.7	18.7	19.1
7½										
8	24.0							22.1	19.5	20.4
8½										
9	26.7							24.8	23.1	23.6
9½										
10	28.4							27.1	26.1	27.2
10½										
11	31.8	29.0	29.1	29.9	28.9			28.9	29.6	29.5
11½										
12	38.3	32.0	35.8	30.0	32.0			33.0	32.7	32.7
12½										
13	41.7	35.5	40.8	36.6	39.3			37.9	35.8	38.1
13½										
14	44.5	40.9	44.9	41.6	45.4			42.8	46.3	44.0
14½										
15	47.2	45.9	46.1	45.4	47.5			46.6		50.8
15½						39.7	39.4			
16	51.3	48.6	48.7	50.4	50.0	38.0		50.3		51.7
16½						41.5	40.5			
17	51.6			53.1		45.0	42.9	50.3		
17½						43.7	44.3			
18				53.9		46.1	45.5	50.1		47.2
18½						47.3	47.3			
19				54.5		48.3	48.1	51.3		
19½						50.0	50.0			
20						51.7	51.0	52.2		
20½						52.7	52.7			
21						54.4	53.5			
22						56.8	55.8			
23										
24						59.8				
25										
26										
27						64.4				
28						**	**			

WEIGHT OF FEMALES IN KILOGRAMS

	American										American and English
Age in Years	24a Macdonald[22]	25 Peckham[23]	27 Porter[24]	28 Porter[25]	29 Robertson[26]	30 Smedley[27]	33a Stiles and Wheeler[28]	33b Stiles and Wheeler[29]	34 West[30]	35 Young[31]	37 Stephenson[32]
5	19.6	18.1							17.9		18.0
5½											
6	20.7	19.6	18.9	18.9	20.1	18.9	20.4	20.4	19.8	18.6	19.4
6½						19.9					
7	22.4	21.3	20.8	20.8	22.4	21.0	22.3	22.2	21.8	21.1	21.4
7½						22.0					
8	24.4	23.1	22.9	22.9	24.3	23.0	23.9	24.2	23.4	24.6	23.6
8½						24.0					
9	26.5	25.6	25.1	25.1	27.1	25.3	26.4	26.5	26.0	30.1	25.5
9½						26.5					
10	29.1	28.3	27.5	27.5	30.0	27.8	29.0	29.2	28.8	30.7	28.2
10½						29.1					
11	33.2	31.2	30.2	30.2	34.1	30.7	32.3	32.0	31.7	34.7	31.1
11½						32.3					
12	37.1	35.3	33.7	33.7	36.6	34.4	38.2	37.4	36.2	38.3	35.1
12½						36.5					
13	42.2	39.9	38.5	38.5	44.1	39.0	43.4	43.8	39.8	38.5	39.8
13½						44.2					
14	45.5	44.3	42.3	42.3	47.9	44.2	44.8	44.6	45.0	46.1	44.3
14½						47.0					
15	47.7	48.0	46.7	46.7		48.2	49.4	49.3	47.6	51.4	47.8
15½						49.4					
16	49.9	50.2	50.3	50.3		50.7	50.8	51.0	49.4	49.7	51.0
16½						52.0					
17	50.6	51.4	52.6	52.6		52.4	52.4	52.8	52.2	56.9	52.3
17½						52.8					
18		51.0	52.4	52.4		52.9			54.4	50.9	52.8
18½						53.1					
19			52.2	52.2					53.7		
19½											
20			53.9	53.9					54.3		
20½											
21											
22											
23											

WEIGHT OF FEMALES IN KILOGRAMS

	English										Norwegian
Age in Years	38 Berry[33]	39a Elderton[34]	39b Elderton[35]	41 Galton[36]	42 Kerr[37]	44a Roberts[38]	45 Shuttleworth[39]	49a Tuxford & Glegg[40]	49b Tuxford & Glegg[41]	49c Tuxford & Glegg[42]	50 Schiötz[43]
5				17.8		18.0	17.8	17.1	17.2	16.9	
5½											
6		18.1	19.0	18.9	20.5	19.2	18.9	18.6	18.7	18.4	
6½											
7		19.5	20.7	21.6	22.9	21.2	21.6	20.5	20.6	20.4	
7½											
8		21.1	22.4	23.6	25.4	23.7	23.6	22.2	22.2	22.2	
8½											
9		22.9	24.6	25.2	27.4	25.2	25.2	24.8	25.1	24.6	
9½											
10		24.8	26.7	28.1	30.0	28.1	28.5	26.7	26.9	26.6	
10½											
11	31.8	27.0	29.2	30.8	33.8	30.9	30.9	29.6	30.3	29.2	
11½											
12	34.0	29.6	32.0	34.7	38.7	34.7	34.7	33.5	33.8	32.8	35.3
12½											
13	38.1	32.8	35.7	39.6	44.1	39.5	39.6	36.3	36.8	35.9	38.6
13½											
14	44.9	34.8	40.4	43.9	48.0	43.9	43.9	39.8	40.1	39.7	44.4
14½											
15	48.1			48.1	51.2	47.5	48.2				47.8
15½											
16				51.3	52.4	51.1	51.3				50.6
16½											
17				52.2	52.8	52.1	52.4				52.3
18				54.9		53.4	54.9				
19				56.2		56.1	56.2				
20				56.0		55.9	56.0				
21				55.2		55.0	55.2				
22						56.3	56.0				
23						57.3	56.3				
24						54.7	54.8				
25						**	**				

WEIGHT OF FEMALES IN KILOGRAMS

	Swedish		Danish			Belgian	French	German			
Age in Years	52a Key[44]	52b Key[45]	53a Hertel[46]	53b Hertel[47]	54 Vahl[48]	55 Quetelet[49]	58 Variot & Chaumet[50]	59a Ascher[51]	59b Ascher[52]	60 Camerer[53]	64 Geissler[54]
5					17.9	15.3				17.5	
5½							15.2				
6					18.9	16.7				19.0	20.5
6½	20.7	20.6	20.0				17.4	19.4	19.1		
7					22.0	17.8				20.7	22.4
7½	21.6	22.2	21.5				19.0	20.6	21.3		
8					24.3	19.0				22.5	24.5
8½	25.0	23.2	23.5				21.2	24.0	23.5		
9					26.8	21.0				24.9	26.2
9½	26.9	25.5	25.5				23.9	25.8	25.0		
10					29.4	23.0				26.4	28.5
10½	29.4	28.0	28.0				26.6	27.3	27.8		
11					33.6	25.5				29.1	31.6
11½	31.9	30.5	30.5	31.0			29.0	29.1	31.2		
12					36.6	29.0				33.7	35.3
12½	35.9	33.9	34.0	34.0			33.8	33.8	35.3		
13					40.7	32.5				37.9	38.6
13½	39.6	37.7	38.0	38.5			38.3	38.2	38.5		
14					46.0	36.3				42.6	
14½	44.8	41.3	42.0	43.5			43.2				
15					49.3	40.0				47.2	
15½	48.9	46.0	46.5	46.5			46.0				
16					45.8	43.5				48.2	
16½	51.6		51.0	51.0							
17						46.8				49.2	
17½	54.6										
18						49.8				50.0	
18½	56.3										
19						52.1					
19½	57.4										
20						53.2					
20½	57.7										
21											

WEIGHT OF FEMALES IN KILOGRAMS

	German								Swiss		Russian
Age in Years	66b Hasse[55]	66a Hasse[56]	70 Radosavljevich[57]	73b Rietz[58]	73a Rietz[59]	73c Rietz[60]	76 Schmid-Monnard[61]	77a Schmidt[62]	82 Ernst[63]	81 Ernst[64]	85a Diek[65]
5							15.6				
5½											
6			19.2	19.6	22.3		18.5	18.2			
6½											
7			20.5	21.6	23.7		19.2	20.3			
7½											
8			23.6	23.3	26.1		21.4	22.0			
8½	23.8	24.6				26.1			22.1	23.8	
9			25.3	24.6	27.7		23.5	24.4			
9½	25.8	27.1				27.8			22.3	24.4	
10			27.6	27.5	30.5		25.3	26.6			
10½	28.2	28.5				32.1			23.9	30.2	23.9
11			30.2	30.2	34.4		28.4	29.5			
11½	31.0	32.7				34.4			24.5	31.3	25.3
12			34.9	34.3	37.9		31.8	32.7			
12½	34.7	36.5				40.5			25.0	32.4	31.0
13			39.1	39.2	41.5		36.2	36.6			
13½	38.0	40.2				43.1			26.5	39.0	33.2
14			44.9	43.0	46.0		40.8				
14½	42.2	44.4				49.7	**		26.8	41.3	41.3
15			48.1		51.6						
15½						51.2					42.6
16					56.2						
16½											45.3
17					59.0						
17½											45.8
18					64.3						
18½											
19					65.4						
19½											
20											
20½											
21											

WEIGHT OF FEMALES IN KILOGRAMS

	Russian								Italian		
Age in Years	85b Diek[66]	86a Erismann[67]	87a Kosmowski[68]	87b Kosmowski[69]	89a Michailoff[70]	89b Michailoff[71]	90a Mouratow[72]	90b Mouratow[73]	96a Pagliani[74]	96b Pagliani[75]	96c Pagliani[76]
5									15.0		
5½											
6		19.4							16.4		
6½											
7		21.3							17.7		
7½				18.9							
8		22.0							19.0		
8½			21.0	21.0	21.3	21.3				22.8	18.5
9		25.6							21.9		
9½			22.3	22.3	23.2	22.0				25.1	20.9
10		27.4							24.7		
10½	29.4		24.7	24.7	25.0	25.6				27.3	23.4
11		30.3							26.9		
11½	31.0		26.9	26.9	27.1	27.3	29.3	21.7		28.5	26.0
12		36.5							29.5		
12½	35.2		30.6	30.6	28.9	30.3	30.9	21.2		31.8	28.5
13		40.5							34.5		
13½	39.2		32.2	32.2	31.9	36.5	33.7	37.7		37.6	31.4
14		42.8							38.5		
14½	44.8		38.1	38.1		40.5	37.7	36.9		43.0	32.9
15		45.3							43.8		
15½	46.6					42.6	38.8	42.8		45.6	36.9
16		45.8							45.7		
16½	48.1						45.0	47.2		45.7	
17									47.5		
17½	49.8						47.6	51.4			
18									48.6		
18½	51.2						51.4	52.2			
19											
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											

WEIGHT OF FEMALES IN KILOGRAMS

	Italian	Japanese			Chinese		Philippine
Age in Years	97 Vitale-Vitali[77]	98 Misawa[78]	99a Misawa[79]	100 Miwa[80]	102 Merrins[81]	103a Whyte[82]	104 Bobbitt[83]
5			14.5	15.6			
5½							
6			16.0	16.8			
6½							
7		16.7	17.2	17.9			18.6
7½							
8		18.7	18.7	19.6			20.3
8½							
9		20.0	20.5	21.8			22.8
9½							
10		21.9	22.3	23.8			23.2
10½	24.6						
11		24.5	24.4	26.1		26.1	26.5
11½	25.1						
12		26.8	27.8	30.0	25.9	28.7	29.8
12½	28.0						
13		30.1	31.4	33.3	32.9	32.8	33.5
13½	31.0						
14		33.5	36.5	38.8	37.4	34.5	36.5
14½	32.6						
15		36.4	38.2	41.2	41.1	39.2	40.0
15½	34.0						
16		39.7		42.3	45.2	40.7	41.6
16½	35.6						
17				45.2	46.7	42.9	43.4
17½	35.7						
18				45.7		46.2	44.0
18½	35.8						
19				45.1	47.2	44.7 **	42.8
19½	34.2						
20				46.0			42.5
20½							
21					52.6		
22							
23							
24							
25							
26							
27							

III. SCHOOL CHILDREN AND ADULTS. WEIGHT OF FEMALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School, well-to-do class, F 638, consecutive measursements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School, well-to-do class, F 100, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, F 60, consecutive measurements. Includes data of final norms, p. 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, F 47, consecutive measurements. Not discussed in previous sections of this *Study*.
5. Bib. 35, 1892, Oakland, M and F 4956.
6. Bib. 88, 1897, American, F 1716.
7. Bib. 88, 1897, Oakland, F 2304.
8. Bib. 109, 1875, Boston, F 10,904.
9. Bib. 110, 1879, Boston laboring class. Taken from Ernst, Bib. 241.
10. Bib. 110, 1879, Boston non-laboring class. Taken from Ernst, Bib. 241.
11. Bib. 295, 1897, Iowa, F 50.
12. Bib. 294, 1895, New Haven, F 50.
13. Bib. 317, 1890, American white, M and F 743.
14. Bib. 317, 1890, American negro, M and F 723.
15. Bib. 317, 1890, Kansas City white, M and F 2055.
16. Bib. 317, 1890, Foreign descent, M and F 385.
17. Bib. 345, 1893, Oberlin College, M and F 500.
18. Bib. 345, 1893, Oberlin College, M and F 1600.
19. Bib. 356, 1902, Nebraska, F 7069.
20. Bib. 403, 1899, Italian descent.
21. Bib. 403, 1899, New York, white and negro asylum children.
22. Bib. 490, 1897-98, Washington, D. C., F 8520.
23. Bib. 580, 1881, Milwaukee, F 4891.
24. Bib. 614, 1893, St. Louis, F 18,059.
25. Bib. 615, 1894, St. Louis, F 16,112.
26. Bib. 6699, 1916, Oakland.
27. Bib. 764, 1900, Chicago, F 3471.
28. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, F 877.
29. Bib. 782, 1915, southern states, homes of good sanitary condition, F 662.
30. Bib. 873, 1896, Worcester, M and F 2350.
31. Bib. 900, 1913, Chicago, favored class, F 144.
32. Bib. 778, 1888.
33. Bib. 58, 1904, London, scholarship girls, F 1384.
34. Bib. 229, 1914, Glasgow, poorer class.
35. Bib. 229, 1914, Glasgow, better class.
36. Bib. 281, 1883, all classes.
37. Bib. 427, 1918.
38. Bib. 663, 1878, all classes.
39. Bib. 752, 1884, general population.
40. Bib. 827, 1911, all England, F 258,834.
41. Bib. 827, 1911, county education areas, F 121,648.
42. Bib. 827, 1911, urban education areas, F 137,186.
43. Bib. 706, 1919, F 177.
44. Bib. 431, 1889, Mittelschulen.
45. Bib. 431, 1889, Volksschulen.
46. Bib. 368, 1882, Volksschulen, F 11,250.
47. Bib. 368, 1882, höhere Schulen. Taken from Ernst, Bib. 241.
48. Bib. 832, 1884.

49. Bib. 628, 1836, F 10 at each age.
50. Bib. 838, 1906, Paris, poorer class.
51. Bib. 18, 1912, Hamm.
52. Bib. 18, 1912, Königsberg.
53. 1911. Taken from Heubner, Bib. 375.
54. Bib. 291 and 292, 1888, Gohlis-Leipzig, F 1420.
55. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 1. Taken from Ernst, Bib. 241.
56. Bib. 353, 1891, Gohlis-Leipzig, Bürgerschule 2. Taken from Ernst, Bib. 241.
57. Bib. 639, 1913, Mostar, Austria, F 615.
58. Bib. 657, 1903, Berlin Volksschulen, F 1365.
59. Bib. 657, 1903, Berlin Gymnasium, F 533.
60. Bib. 657, 1903, Berlin höhere Schulen. Taken from Ernst, Bib. 241.
61. Bib. 723, 1901, Halle, F 1177.
62. Bib. 724, 1892, Saalfeld Bürgerschulen, F 4807.
63. Bib. 241, 1906.
64. Bib. 241, 1906, Zürich Volksschulen, F 175.
65. Bib. 210, 1883, schools and asylums. Taken from Wiazemsky, Bib. 878.
66. Bib. 210, 1883, institutions. Taken from Wiazemsky, Bib. 878.
67. Bib. 238 and 239, 1888, Moscow, F 1495.
68. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
69. Bib. 448, 1894, Warsaw, F 1898.
70. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
71. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
72. Before 1907, cigarette makers, city. Taken from Wiazemsky, Bib. 878.
73. Before 1907, cigarette makers, country. Taken from Wiazemsky, Bib. 878.
74. Bib. 573 and 574, 1875-79, Turin, F 968.
75. Bib 573 and 574, 1875-79, Turin, favored class. Taken from Ernst, Bib. 241.
76. Bib. 573 and 574, 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
77. Before 1907. Taken from Wiazemsky, Bib. 878.
78. Bib. 528, 1909, M and F 869,014.
79. Bib. 528, 1909, F 7466.
80. Bib. 529, 1893, F 2800.
81. Bib. 519, 1910, students, F 69.
82. Bib. 876, 1918, south provinces, F 613.
83. Bib. 103, 1909, F 428.

PART VI

CHAPTER XI

ANNOTATED BIBLIOGRAPHY
(911 Titles)

*1. AHLFELDT,— *Ernàhrung des Säuglings an der Mutterbrust.* Leipzig: 1878.
Reports weight of three infants.

2. AITKEN, W. *On the Growth of the Recruit and the Young Soldier.* London: 1862. pp. 72.
A preliminary study of the British soldier.

3. ALBERT, J. AND ARVIZÚ, T. Physico-Mental Development of Filipino Children. *Actas. mem. y comun. de la 3 Assembl. reg. de med. y. farm. de Filipinos,* Manila: 1917, 421-432.

4. ALFEYEFF, I. Y. (Correlations of Weight, Height and Chest Measurements in Man) *Voyenno-Med. J.,* 1912, (233), med.-spec. pt., 503-540. Russian.

5. ALLARIA, G. B. Richerche anthropometriche sulla crescenza della fanciulle povere. *Ramazzini,* 1912, (6), 60-86.

*6. ALTHERR,— *Über regelmässige tägliche Wägungen der Neugeborenen.* Diss. Basel: 1874.

7. AMMON, O. Anthropologische Untersuchungen der Wehrpflichtigen in Baden. *Virschow-Holzendorf's Samml. gemeinverständl. wissenschaftl. Vorträge,* 1890, Part 101.

8. AMMON, O. Die Körpergrösse der Wehrflichtigen im Grossherzogtum Baden in den Jahren 1840-1864. *Beiträge zur Statistik des Grossherzogtum Baden.* 1894. n. f. Part 5.

9. ANGERSTEIN, W. *Die Massverhältnisse des menschlichen Körpers, und das Wachstum der Knaben.* Köln: 1865. Pp. 10.

10. ANONYMOUS Pignet's Standard and Chinese Students. *Boston Med. and Surg. J.,* 1916, (194), 329-330.
A brief editorial reporting the work of Firth on East Indians and of Black on Chinese, revealing the poor physical condition of these peoples. No tables.

11. ANONYMOUS A Physical Census (in England) and its Lesson. *Brit. Med. J.,* 1918, 348-349.
Results of the physical examination of drafted men for the first eight months of 1918 show that only 36 to 37 per cent were placed in class A.

12. ANONYMOUS *J. Amer. Med. Ass'n.,* 1920, (74), 329.
Editorial comment on an article by Pfaundler (Über Körpermasse von Münchener Schulkindern während des Krieges. *Münch. med. Woch.,* Aug. 1, 1919, No. 31, 859). Pfaundler showed that boys and girls grew less during the war years and that the average decrease in gains was more conspicuous in children of professional classes than in those of less well-to-do classes. War acted as a leveller of classes from the somatic as well as from other standpoints.

13. ANTHONY,— Études anthropométriques sur la taille, le perimétre thoracique et le pois des hommes de 20 à 25 ans. *Atti d. 11 Cong. med. internaz.* 1884, (6), chir. e. med. Mil. 81.

This study shows the decreasing increments of growth in adults.

14. ANUTSCHIN,— (On the Geographical Distribution of the Male Population of Russia in Respect of Height). *Trans. Imperial Geog. Soc.*, (7), part 1.
Russian, cited by Sack.

15. ARKLE, A. S. The Correlation of Physical and Mental Development. *J. Roy. Inst. Pub. Health,* London: 1908, (16), 741-748.

16. ARON, H. Untersuchungen über die Beeinflussung des Wachstums durch die Ernährung. *Berl. klin. Woch.,* 1914, (51), No. 21, 972-977.
The experimenter fed animals on various sorts of inadequate diets and compared the resulting curves for increase of height and weight with curves for infants that had been similarly handicapped in growth. The height curves showed in both cases a closer approximation to normal than did the weight curves. After interruption due to malnutrition the curve usually rose again but normal full growth was unlikely to occur.

17. ARTHAUD, G. Estudio sobre la curva de crecimiento y sobre las variaciones del peso del hombre. Transl. *Gac. méd catal.,* 1885, (18), 478-481. Also (in French) *Progrès méd.,* 1893, 2 s. (18), 397-400.

18. ASCHER,— Über Schülerfürsorge. *Zsch. f. Medizinalbeamte,* 1912, (25), 79-89.
For this investigation 14,000 children of Königsberg and 7087 children of Hamm were measured. The article gives a table of weights for each one centimeter increase in height.

*19. ASTENGO, A. *Rapport du poids des enfants à la durée de la grossesse.* Paris: 1905. Pp. 48.
A study of length of pregnancy as it affects weight.

20. AUBOYER, L. *De la croissance et de ses rapports avec les maladies aiguès fébriles de l'enfance et de l'adolescence.* Thesis, Lyon: 1881.

21. AUDRAN, G. *Les proportions du corps humain mesurées sur les belles figures de l'antiquité.* Paris: 1683. Pp. 26.
An elaborate study with diagrams and measurements of twenty-five famous statues.

*22. AUSSET,— Les stagnations de poids chez les enfants et particulièrement chez les nourrissons. *Bull soc. de pédiat. de Paris,* 1904 (6), 193-209.

23. BACHAUER,— AND LAMPERT,— Vorschläge zur einheitlicher Organization der Kinderwägungen und-messungen. *Zsch. f. Schulgesundheitspf.,* 1919, (32), 97-109.
Some considerations of importance in the technique of measurement.

24. BALDWIN, B. T. Individual Differences in the Correlations of Physical Growth of Elementary and High School Pupils. *J. of Ed. Psychol.,* 1911, (2), 150-152.
Abstract. A preliminary report of the beginnings of the investigation included in *Physical Growth and School Progress.*

25. BALDWIN, B. T. *Notes on School Observation. The Physical Nature of the Child.* (Univ. of Texas Bull. No. 188), 1911. Pp. 26.
This is a general outline designed as a guide to teachers in observing the grosser physical defects, with charts and tables on physical growth.

26. BALDWIN, B. T. A Psycho-Educational Study of the Fourth and Fifth School Grades. *J. of Educ. Psychol.,* 1914, (4), 364-365.

A short report of a longer study of the interrelations between chronological, physiological and pedagogical age. Taller and heavier boys and girls, who are also the younger of the two groups, mature earlier and complete the elementary school work at an earlier age and with a higher average mark than do the short light or physiologically retarded boys and girls.

27. BALDWIN, B. T. *Physical Growth and School Progress.* Washington: U. S. Bur. of Educ., 1914, No. 10. Pp. 212.

This is an extensive series of measurements at yearly and half yearly intervals of 861 boys and 1063 girls in elementary and high schools of Chicago and New York City. The records include consecutive measurements on the same individuals (nude) for periods of three to 12 years, of height, weight and lung capacity, together with the school marks of these same children from grade to grade. The data are carefully analyzed in 34 tables and 39 charts, which show that these children are on the average better developed physically than those measured for the norms of other investigators. The conclusion is drawn that "if pedagogical age is accepted as a fair equivalent in these three different schools, for mental development, the tall heavy boys and girls, with good lung capacity, are older physiologically and further along in their stages toward mental maturity as evidenced by school progress, than the short light boys and girls."

28. BALDWIN, B. T. A Measuring Scale for Physical Growth and Physiological Age. *Fifteenth Yearbook of the Nat. Soc. for the Study of Educ.* Bloomington, Ill.: Pub. Sch. Pub. Co., 1916, Part 1, 11-23.

The material and charts in this article are supplementary to a previous study *Physical Growth and School Progress.* Score cards are presented for boys and girls 5½-17½ years, giving the Baldwin and the Boas norms for height, weight and lung capacity, with graphs on which the child's development can be plotted for comparison with these norms. A chart with growth curves for height, of eight girls, measured over an extended period is given, showing the time of appearance of menstruation. These curves show that tall girls as a rule mature earlier than shorter ones. A distribution table of pubescent changes in 1241 girls is given. Another chart shows the distribution of pre-pubescent and post-pubescent boys (1317 from the city, 3600 from the country). From this it appears that the pubescent changes occur earlier in country boys.

29. BALDWIN, B. T. *The Physical Growth of School Children.* (Univ. of Iowa Extens. Bull. No. 59) Iowa City, Iowa: Univ. of Iowa, 1919.

Describes the Iowa Plan of making and recording measurements and gives norms and score cards developed by Baldwin.

30. BALDWIN, B. T. *Experimental Studies in Education.* Baltimore: Johns Hopkins University, 1920. Pp. 80.

Contains correlations of psycho-educational with physical measurements from the Johns Hopkins Demonstration School.

*31. BAMBERG, K. Zur Frage der Rohmilchernährung. *Jahrb. f. Kinderheilk.*, 1913, (71), 670-682.

This article is mostly concerned with the nutrition of infants. It contains a number of individual growth curves (some for almost a year) with notes on feeding.

32. BARDEEN, C. R. *The Height-Weight Index of Build in Relation to Linear and Volumetric Proportions and Surface-Area of the Body During Post-Natal Development.* (Wisconsin Contrib. to

Embryology, No. 46. Extracted from Public. 272, Carnegie Instit. of Washington, 483-554.) Madison: Univ. of Wisconsin. No date, about 1918.

This monograph presents a study of the height-weight ratio as an index of the proportions of the human body for purposes of coördinating investigations in gross anatomy. Eleven charts and twenty-eight tables selected from original data by Boas, Baldwin, Hastings, Quetelet and others, are included. The original contributions are primarily the growth height-weight index norms and the adaptation of formulae for correlating bodily surface and bodily volume. A short list of references is attached.

33. BARDEEN, C. R. *Height-Weight Chart for School Boys.* (Bull. of the Univ. of Wisconsin) Madison: Univ. of Wisconsin, Feb., 1920.

This is a chart constructed from data from many sources. Vertical lines represent weight in pounds and horizontal lines stature in inches. Oblique black lines are drawn to represent a series of boys of the same age, but varying in height and weight, while oblique red lines represent determined indices of build. The index of build corresponding to relative bulk is obtained by dividing the weight in pounds by the cube of the stature in inches and multiplying the quotient by 1,000. The chart can be used for individual diagnosis by plotting directly upon the graph the measurements of any child between the ages of three and twenty.

34. BARDEEN, C. R. *Height-Weight Chart for School Girls.* (Bull. of the Univ. of Wisconsin) Madison: Univ. of Wisconsin, Feb., 1920.

Similar in construction to the chart for boys.

35. BARNES, E. Physical Development of Oakland Children. *Oakland Sch. Rep.*, 1892-93, (93), 38-44.

A study of the physical development of about 6000 Oakland school children, with charts and tables showing height, weight, and age and the occupations and nationalities of the children. The children from Oakland were heavier and taller than the children from Boston, Worcester, Toronto, St. Louis, and Milwaukee, whose records were displayed at the World's Fair in Chicago in 1892.

36. BARR, ANNE L. Some Anthropometric Data of Western College Girls. University of Nebraska. *Am. Phys. Educ. Rev.*, 1903, (8), 245-248.

A brief discussion of the effect of environment in producing good physical development.

37. BARTUCZ, L. Die Körpergrösse der heutigen Magyaren. *Arch. f. Anthropol.*, n. f., 1916, (15), 44-59.

*38. BAUDRAND, M. *L'accroissement;* ses caractères normaux et anormaux chez le nourrisson: ses rapports avec l'hérédité, plus spécialement dans les états morbides (syphilis, alcolisme et tuberculose). Paris: Doin et fils, 1911. Pp. 648.

The title is explanatory of the contents of this important book, which contains many graphs, showing the growth of infants under these conditions.

39. BAXTER, J. H. *Statistics, Medical and Anthropological, of the Provost General's Bureau.* Washington: 1875, (1).

This is an important comparative study showing that the size of adult Americans is very different in different states of the Union, and even in different parts of the same state. There is apparently an influence of climate upon growth.

40. BAYERTHAL,— Kopfgrösse und Intelligenz im Schulpflichtigen

Alter. *Zschr. f. exper. Pädag.*, 1910, (10), Heft 2-3, 197-218. See also 1905, (2), 247-251; 1906, (3) 238-242; 1907, (5) 223-228.

Measurements are given of the head circumference of several thousand school children who were also rated in five grades by their teacher or by the investigator, as regards intellectual ability. These ratings were made presumably on the basis of excellence in reasoning, rather than mere memorizing. The conclusion is drawn that large-headedness is directly correlated with intelligence, and can be used for diagnostic purposes. In view of the coarseness of the intellectual grading and the extreme subjectivity of this rating, the statistics are of doubtful value.

41. Bean, R. B. A Preliminary Report on the Measurements of About 1000 Students at Ann Arbor, Mich. *Anat. Rec.*, 1907, (1), 67-68. Appears in *Amer. J. Anat.*, 1907-08, (6).

Measurements were made of 910 boys and 116 girls of the freshman class. No tables are given, but the results are used for a discussion of racial types.

42. Bean, R. B. The Stature and the Eruption of the Permanent Teeth of American, German-American, and Filipino Children. *Amer. J. Anat.*, 1914, (17), 113-160.

Data on 776 Filipino, 628 German and 812 American boys and girls. No age curves are given for stature. Filipinos mature earlier in stature and eruption of teeth.

43. Bean, R. B. The Growth of the Head and Face in American (white), German-American and Filipino Children. *Anat. Record*, 1915, (9), 50-52.

This is an abstract of an address and therefore has no tables. In general, American children show the greatest growth with respect to these measurements, next German, and last Filipino children.

44. Beddoe,— On the Physical Characteristics of the Jews. *Trans. of the Ethnol.* Soc., London: 1861, (1), 223.

A study included primarily for its historical significance.

45. Beddoe,— On the Stature and Bulk of Man in the British Isles. *Memoirs of the Anthropol. Soc.*, London: 1870, (3), 545.

A pioneer study of physical development.

46. Beik, A. K. Physiological Age and School Entrance. *Ped. Sem.*, 1913, (20), 277-321.

A general discussion without tables, pointing to the conclusion that physiological development should have advanced sufficiently before children should be admitted to school. Five pages of references.

47. Belaiew,— (*Matériales pour l'étude sanitaire des indigents du g. de Simbirsk.*) Diss. St. Petersburg: 1886. Russian, cited by Wiazemsky.

Materials for the health study of the poor of Simbirsk.

48. Belyaieff,— (*Materials for Investigating the Influence of Schools on the Physical Development of Pupils.*) Diss., St. Petersburg: 1888. Russian, cited by Sack.

49. Benders, A. M. De Toeneming der lichaamslengte van de mannelijke bevolking in Nederland. *Nederl. Tijdschr. v. Geneesk.*, 1916, (1), 1438-1449.

50. Benedict, F. G. A Photographic Method for Measuring the Surface of the Human Body. *Amer. J. of Physiol.*, 1916, (41), 275.

The method is new and suggestive.

*51. Benestad, G. Die Gewichtsverhältnisse reifer norwegischer Neuge-

borener in den ersten 12 Tagen nach der Geburt. *Arch. f. Gynäk.*, 1913, (101), 292-350.

A careful analysis of data from 1,979 infants with a bibliography of 46 titles. Many tables and graphs.

*52. BENESTAD, G. Wo liegt die Ursache zur physiologischen Gewichtsabnahme Neugeborener? *Jahrb. f. Kinderheilk.*, 1914, (80), 21-41.

A good review of the literature with references. Benestad believes the loss to be due to an insufficiency in the total metabolism.

*53. v. d. BERGH, A. A. H. Over voeding en voedingsstoornissen in het eerste levensjaar. *Geneesk. Bl. u. Klin. en. Lab. v. de prakt.*, 1893, (5), 51-86.

*54. BERGMANN, E. Die physiologische Gewichtsabnahme und die Beziehung zwischen Ernährung und Gewichtsverlauf bei 1000 Neugeborenen. *Zsch. f. Kinderheilk.*, 1916, (14), 149-165.

The writer found that 21.7% of these infants reached the birth weight by the end of the second week, 15.3% more reached it by the end of the third week, 24.1% more by the end of the fourth week.

55. BERGMÜLLER, J. G. *Geometrischer Maasstab der Säulenordnung und Anthropometria, oder Natur des Menschen.* Augsburg: 1723.

56. BERLINER, M. Über die Beziehung des proportionellen Brustumfanges zum Index der Körperfülle bei männlichen Individuen im Wachstumsalter. *Berl. klin. Woch.*, 1920, (57), 33-34.

An investigation of 60 boys 10-18 years of age in a clinic showed that with increased chest circumference there was an increase in the "Index der Körperfülle."

57. BERLINERBLAU, M. (*The Physical Development of the Children in an Orphan Asylum.*) Moskau: 1908. Russian.

58. BERRY, F. M. D. On the Physical Examination of 1580 Girls from the Elementary Schools in London. *Brit. Med. J.*, 1904, Part 1, 1248-1249.

These are measurements on girls who held scholarships. Table of height and weight is given for ages 11 to 15. (For similar data on scholarship boys see Thorne).

59. BERTILLON, A. Les proportions du corps humain. *Rev. scient.*, 1889, (43), 524-529.

An important anthropometric contribution for recording comparative measurements of individuals.

60. BERTILLON, A. *Signaletic Instructions; Including the Theory and Practice of Anthropometrical Identification.* Chicago and New York; 1896. Pp. 260.

61. BEYER, H. G. Observations on Normal Growth and Development under Systematized Exercises. *Rep. of Chief of Bur. of Med. and Surg. to the Sec. of the Navy.* Washington: 1893, 149-160.

62. BEYER, H. G. The Application of the Mean Values Derived from a Large Number of Measurements to the Annual Physical Examination of Cadets of the Naval Academy. *Rep. Sug. Gen. Navy,* 1894, 105-110.

63. BEYER, H. G. Growth of the United States Naval Cadets. *Proc. of the U. S. Naval Inst.*, 1895, (21), 297-333.

A simple presentation of methods of computing physical measurements, the application of percentile grades, and a series of 48 tables.

64. BEYER, H. G. The Influence of Exercise on Growth. *Amer. Phys. Educ. Rev.*, 1896, (1), 76-87.
Also in *J. of Exper. Med.*, 1896, (1), No. 3.
Averages obtained from a group of applicants for admission to a military training academy are compared with the averages of men who have had this military training. Comparisons are also made between two groups of cadets whose individual growth records for four years are at hand. It was found that the groups of men who had had systematic exercise at the Academy were physically superior to those who had not had this exercise. It appears to the reviewer that some of this superiority could be attributed to other causes.

65. BEYER, H. G. Relation Between Physical and Mental Work. *Amer. Phys. Educ. Rev.*, 1900, (5), 149-160.
Confirms the important results of Porter's researches on "Precocity and Dullness," suggests a change in the physical examinations in public schools, and advocates the use of the percentile grade tables in Massachusetts.

66. BÉZY, P. Étude clinique sur la croissance. *Méd. inf.*, 1894, (1), 255-265.

*67. BIEDERT, P. Wagestudien. *Jahrb. f. Kinderheilk.*, 1883, (19), 275-308.
Discussion of the factors that influence the technique of weighing, together with a contribution toward establishing the food requirements of infants.

68. BINET, A. Recherches complémentaires de céphalométrie sur 100 enfants d'intelligence inégale, choisis dans les écoles primaires du départment de Seine et Marne. *Année psychol.*, 1900, (7), 375-428.
It was found that the more intelligent had larger heads.

69. BINET, A. La croissance du crâne et de la face chez les normaux entre 4 ans et 18 ans. *Année psychol.*, 1901, (8), 345-362.
Head measurements (16 items) are reported in tables and compared with the findings of Quetelet, Bowditch, and Vitali.

70. BINET, A. Les frontières anthropométrique des anormaux. *Bull. de la soc. libre pour l'étude psychol. de l'enfant*, 1904.
Deals with the physical development of feebleminded children.

71. BINET, A., Les signes physiques de l'intelligence chez les enfants. *Année psychol.*, 1910, (16), 1-30.
Interesting historically. It contains a few tables of head measurements but deals mostly with stigmata.

72. BINET, A. AND SIMON, T. *Mentally Defective Children.* Transl. New York: Longmans, Green & Co., 1914. Pp. 179.
Norms or so-called "frontiers of abnormality" for boys 6-18 years are given for height and head measures, page 92.

73. BINET, A. AND VASCHIDE, N. Mesures anatomiques chez 40 jeune garcons. *Année psychol.*, 1897, (4) 133-136.
Reports measurements of weight, height and 12 other items for 12-year-old children.

74. BIRD, F. Über die relativen Massverhältnisse des menschlichen Körpers. *Zsch. f. Anthropol.*, 1823, 330-369.
An important early investigation.

*75. BIRK, W. Unterernährung und Längenwachstum beim neugeborenen Kinde. *Berl. klin. Woch.*, 1911, (48), 1227-1231.
This article presents seven curves of individual children measured each week from birth until they left the hospital. Camerer's normal curve of average length is plotted on each graph. The length curves for normal breast fed infants are very similar

to those of Camerer but those of poorly nourished infants show a decided inferiority not only in weight but also in length. This is contrary to the findings of Freund, who found that length is not influenced by poor nutrition. Birk explains this conflict by saying that the children he observed were younger than those of Freund and that the growth was therefore more seriously retarded.

76. BLAGOVIDOFF, I. (*Materials for the Investigation of the Health of the Mongolian-Asiatic Races* (*Inorodze*) *in the Province of Simbrisk*). Diss., St. Petersburg: 1886.
Russian, cited by Sack.

*77. BLEYER, A. Periodic Variations in the Rate of Growth of Infants. *Arch. of Pediat.*, 1917, (34), 366-371.
For this investigation 1000 St. Louis babies were measured. Two charts show the average weekly gains during the first and second years. Malling-Hansen's findings are corroborated—minimum growth between mid-April and mid-July, maximum between mid-July and mid-December. These variations are less marked for breast fed infants.

78. BLEYER, A. (Measurements of 2000 School Children) *Arch. de méd. d. enf.*, 1919, (22), 311. Abstr. in *J. Amer. Med. Ass'n.*, 1919, (73), 152.
This research done for the American Red Cross Children's Bureau compares the weight and height of 2000 school children of Vienne, a manufacturing town of France, and of the United States. The Vienne children surpassed the others in height and weight.

79. BOAS, F. Anthropological Investigations in Schools. *Ped. Sem.*, 1891, (1), 225-228.
A general discussion, with many historical references as to methods of procedure.

80. BOAS, F. Physical Characteristics of the Indians of the North Pacific Coast. *Amer. Anthropol.*, 1891, (4), 25-32.
Studies based on measurements of 263 Indians from Oregon, Washington, and British Columbia, including stature, sitting height, cephalic index, length of arm, etc.

81. BOAS, F. Physical Characteristics of the Tribes of the North Pacific Coast. *Brit. Ass'n. for the Adv. of Sci.*, 1891, (61), 424-447.
A detailed study of 26 measurements on a number of individual male and female Indians. No averages are given.

82. BOAS, F. Growth of Children. *Science*, 1892, (20), 351-352., n. s. 1897, (5), 570-573.
In this investigation in Worcester the same children were measured twice (May, 1891, and May, 1892). Young children grow more uniformly than older children and growth is more variable with girls than with boys. Short children continue growing for a longer time than do tall children.

83. BOAS, F. The Correlation of Anatomical or Physiological Measurements. *Amer. Anthropol.*, 1894, (7), 313-324.
A discussion of the theory of measurements based on measurements of the heads of 377 half-blood Indians, superseded by later work.

84. BOAS, F. On the Growth of First-Born Children. *Science*, n. s. 1895, (1), 402-404.
This article contains four very valuable tables on the height and weight and yearly increments of boys and girls between 6½ and 17½ years of age. The study includes the first, second, third,

fourth and later born children The conclusions are that in stature and weight the first-born children exceed the later born children. The study includes Toronto and Oakland children; the latter exceed all others in the United States (at this time) in height and weight.

85. BOAS, F. Zur Anthropologie der nordamerikanischen Indianer. *Zsch. f. Ethnol.*, 1895, 366-411.

86. BOAS, F. On Dr. Townsend Porter's Investigations of the Growth of the School Children of St. Louis. *Science*, n. s., 1895, (1), 225-230.
A theoretical discussion and some mathematical objections to Porter's work.

87. BOAS, F. The Forms of the Head as Influenced by Growth. *Science*, n. s., 1896, (4), 50-51.
This is a discussion of Ripley's article with further data on Europeans.

88. BOAS, F. The Growth of Toronto Children. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (6), 443-449.
Standing and sitting height, finger reach and weight are given for Toronto boys and girls, 5½ to 16½ years. Comparisons with Oakland, Calif., children are made. Variability and differences in stature of first-born and later-born children are discussed.

89. BOAS, F. The Growth of Toronto Children. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1896-97, (2), 1541-1599. See also *Brit. Ass'n for the Adv. of Sci.*, 1897, (6), 443-449.

90. BOAS, F. Summary of the Work of the Committee in British Columbia. *Brit. Ass'n. for the Adv. of Sci.*, 1898, (68), 667-683.
A summary of the measurements on the Indians of the North Pacific Coast, containing 12 extensive tables for 19 measurements on males from 5 to 70 years old.

91. BOAS, F. Statistical Study of Anthropometry. *Amer. Phys. Educ. Rev.*, 1902, (6), 174-180.

92. BOAS, F. *The Measurement of Variable Quantities.* In Columbia Univ. Contrib. to Philos. and Psychol., New York: Columbia University, 1904, (14), 1-50.
A detailed technical discussion on constants and variables; a comparison between limited series of observations and the unlimited series of variables and the distribution of variables and of chance variations.

93. BOAS, F. *Anthropometry of Central California.* Bull. Amer. Mus. Nat. Hist., 1905, (17), 247-380.

94. BOAS, F. The Relation between Civilization and Stature. *J. Sociol. Med.*, 1909, (18), 397-401.

95. BOAS, F. Changes in Bodily Form of Descendants of Immigrants. *U. S. Senate Documents*, Washington: Gov. Print. Off., 1911, (64). Pp. 573.
This is a painstaking and comprehensive collection of data on physiological development in various nationalities—Bohemian, Hungarian, Polish, Hebrew, Sicilian, Neopolitan and Scotch—revealing a change in type since the time of immigration.

96. BOAS, F. Growth. *Monroe's Cyclopedia of Education.* New York: Macmillan, 1912, (3), 187-190.
An excellent summary of the relation of physical growth to the general problem of education, with tables giving stature, sitting height, weight, length of head, width of head, length of forearm, and width of hand for boys and girls.

97. BOAS, F. Remarks on the Anthropological Study of Children. *Trans. 15th Intern. Cong. Hyg. & Demogr.*, 1912, (3), Part 1, 413-420.

A good general account of the phenomena of growth. No tables.

98. BOAS, F. The Growth of Children. *Science*, 1912, (36), 815-818.

A brief discussion of some of the general laws of growth with special emphasis on pubescent phenomena.

99. BOAS, F. Einfluss von Erblichkeit und Umwelt auf das Wachstum. *Zsch. f. Ethnol.*, 1913, (45), 615-627.

100. BOAS, F. AND WISSLER, C. Statistics of Growth. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1904, (1), 25-132.

This is an exceedingly valuable collection of data. In a previous paper (Report of the Commissioner 1896-1897) Boas showed that the assumption of a symmetrical distribution of variations in period—i. e. of accelerations and retardations—following the laws of chance, gives an adequate explanation of the character of the observed curves of growth. If this theory is correct, it follows that the developmental stage of a child at a certain period depends primarily on phenomena of retardation and acceleration which influence the whole body at the same time, so that all measurements of the body would tend to lag behind the normal average or to be in advance of it. The more rapid the rate of growth the greater would be the effect of variations in period upon all the different measurements. Retardation of developmental period, for instance, would considerably depress all the measurements of the individual. Consequently, the correlations between different measurements ought to be closer during periods of rapid growth than at other periods. Statistical analysis of many tables of measurements taken in Worcester, Mass., Toronto, Ontario, and Milwaukee, Wisconsin, show exactly the variations that correspond to this theory.

101. BOAS, F. New Evidence in Regard to the Instability of Human Types. *Proc. Nat. Acad. Sci.*, 1916, (2), 713-718.

102. BOAS, F. The Anthropometry of Porto Rico. *Amer. J. of Phys. Anthropol.*, 1920, (3), 247-253.

This article reports height and other measurements of 309 children. (See also Spier) Porto Ricans are found to be shorter than Mexican and Italian children, but are not really physiologically retarded as this would seem to indicate.

103. BOBBITT, J. F. The Growth of Philippine Children. *Ped. Sem.*, 1909, (16), 137-168. Also 104-112.

A study of the measurements of 1180 native Filipino boys and 438 girls between the ages of six and 20 years, together with a discussion of growth stages and a comparison with the Smedley and Boas norms. A comparison is also made of the growth of the Filipino children with the growth of the Japanese children as given by Misawa.

104. BOLK, L. Over de toeneming in lichaamslengte der mannelijke bevolkung van Nederland. *Nederl. Tijdschr. v. Geneesk.*, 1910, (45), 650-666.

105. BONDYREW,— (Materials for the Study of the Growth of Children.) Diss., 1902.

Russian.

*106. BOUCHAUD,— *De la mort par inanition.* Thesis, Paris: 1864.

One of the earliest studies giving norms for the growth of infants.

107. BOUDIN, J. C. M. Études ethnologiques sur la taille et le poids de

l'homme chez divers peuples. *Recueil de mémoires de méd. de chirurg.*, 1863, (9), 169-207; (10), 1-43. Third series.
This is particularly concerned with military requirements. The writer finds fewer exemptions because of shortness of stature have taken place in the last thirty years.

108. BOULTON, P. Some Anthropometrical Observations. *Brit. Med. J.*, 1876, Part 1, 280-282.
Contains tables of norms for foetal development and for the growth between 1-12 years, based on the assumption that there is a certain constant relationship between weight and height which holds good during a particular growth period. The writer maintains that weight alone is no criterion of normal development, but that height must also be considered.

109. BOWDITCH, H. P. The Growth of Children. *8th Ann. Rep., Mass. Board of Health.* Boston: 1875, 273-323.
The data for this investigation were collected from 24,500 children in the public schools of Boston and near-by communities and a few private schools. Comparative study is made of the growth in height and weight and the tables are arranged in such a way that the influence on growth by nationality may be determined.

110. BOWDITCH, H. P. Growth of Children. *10th Ann. Rep. Mass. Board of Health.* Boston: 1879, (10), 33-62.
This investigation is supplementary to the previous one and contains 11 tables and 11 plates. The tables give the percentage and then the occupations of parents in professional, mercantile, and unskilled labor classes.

111. BOWDITCH, H. P. The Relation Between Growth and Disease. *Trans. Amer. Med. Ass'n.*, 1881, (32), 370-376.
This is a valuable discussion based on the thesis that "It seems probable that the actual determination of the normal rate of growth will not only throw light upon the nature of the disease to which childhood is subject, but will also guide us in the application of therapeutic measures."
An individual study of the rate of growth of one girl between the ages of 2 and 3 years is included, based on 26 measurements in weight with accompanying health notes from 4 observations.

112. BOWDITCH, H. P. The Physique of Women in Massachusetts. *Rep. Mass. Board of Health.* Boston: 1890, 287-304.

113. BOWDITCH, H. P. The Growth of Children Studied by Galton's Percentile Grades. *22nd. Ann. Rep. Mass. Board of Health.* Boston: 1891, (22), 479-525.
Abstract contained in *Amer. Ass'n for the Adv. of Phys. Educ.*, 1891, (6), 36-37.
Applying this method to 24,000 Boston school children, Bowditch concludes: I. The period of accelerated growth in height and weight occurs just before the age of puberty. Large children have their period of accelerated growth at an earlier age than small ones. II. The period when the girls are taller and heavier than the boys occurs earlier in the higher than in the lower percentile grades.

114. BOYD, R. Table of Weights of the Human Body and Internal Organs in the Sane and Insane, etc. *Phil. Trans.*, London, 1861, (151), 241-262.
This table includes ages from before birth to 80 years old and the results show that the body and internal organs arrive at full size in both sexes between 20 and 30 years of age. "The average height of the adult male varied from 67.8 to 65 inches,

and of the female from 63.2 to 61.6 inches, while the mean weight of the former varied from 112.12 to 91.5 pounds, as compared with the sane adults dying at the same period of life." The tables cannot, however, be used as norms, since one determination will be given for ages 7-13, another for 14-19, etc.

*115. BRADY, J. M. Relation of the Weight Curve of the Infant to the Food. *Amer. J. Obstet.*, 1913, (67), 601-609.
Ten charts show the effect of the deprivation of food, excessive diet, etc. on weight. No age growth curves.

116. BRANDT, G. *Die Körpergrösse des Wehrpflichtigen des Reichlandes Elsass-Lothringen.* Strassburg: Trübner, 1898. Pp. 89.

117. BRAUNE, C. W. AND FISCHER, O. Über den Schwerpunkt des menschlichen Körpers. *Abhandl. der math.-physischen Classe d. K. Sächs. Gesellsch. d. Wissensch.*, 1889, (15), 559.
A study of the center of gravity of the human body.

118. BRENT, W. B. On the Stature and Relative Proportions of Man at Different Epochs and in Different Countries. *Brit. Ass'n. for the Adv. of Sci.*, Sept., 1844.
An abstract of a paper giving measurements of 1000 individuals. The average height of the Englishmen is placed at 5 ft. 7½ inches.

119. BRENT, W. B. Tables Illustrative of the Height, Weight and Strength of Man. *Brit. Ass'n for the Adv. of Sci.*, 1845, (15), 80-81.
In these tables men are grouped as tall, middle height and short.

120. BRESCIANI-TURRONI, C. Über die Korrelation zwischen Körpergrösse und Kopfindex. *Arch. f. Rassen u. Gesellsch. Biol.*, 1913, (10), 452-269.
Reports many correlations for different regions of Italy. The correlations were in general small, and some were negative.

*121. BRESLAU,— Über die Veränderung im Gewichte der Neugeborenen. *Denkschr. d. med. chir. Gesellschaft d. Kantons Zürich*, 1860.

*122. BRESLAU,— Neue Ergebnisse aus Schädelmessung an Neugeborenen. *Wien. med. Woch.*, 1862, (50), 785-787.
The author concludes that the head circumference of boys is in all cases greater than that of the girls, i. e., whether the weight of the former be the same or greater or less than the latter and whether the birth be full time or premature.

123. BREZEZÍNSKI, J. AND PELTŸN, B. (The Child of the Factory Workman in Zawietle in the Light of Anthropometric Measurements) *Zdowie*, Warszawa, 1914, (30), 572-581.
Russian.

124. BRIGHAM, W. T. Measurements of 300 Chinese. *Proc. Boston Soc. Nat. Hist.*, 1866, (11), 98.
A report on 300 adult Chinese measured on board ship. The mean and extremes for weight, height and chest size are reported. No age tables are given.

125. BRITISH ARMY MEDICAL DEPARTMENT. Ages, Height, Weight, and Chest Measurements of All Recruits Finally Approved for Service During the Year. *Army Med. Dep. Rep.* for 1894, (36), 31-35; for 1895, (37), 30-34; for 1896 (38), 33-37; for 1901, (43), 40-44.

*126. BROUDIC, L. Contribution à l'étude de la progression du poids du nourrisson au cours de la première année. *Nourrisson*, 1919, (7), 15-22. Abstr. in *J. Amer. Med. Ass'n.*, 1919, (72), 1036.
From observations on 2000 infants, the writer took the records

of 300 who had all been weighed at birth and several times thereafter. He gives the weight for 2, 4, 6, 8, 10, 13, 17, 22, 26, 30, 34, 39, 43, 45, 47, 49, 51 and 52 weeks, the averages being based upon 30 to 207 observations for each figure. From these a graph is plotted for increase of weight during the first year. A comparison of his figures for several age points is made with those of Marfan.

127. BROWN, C. R. Anthropometric Notes on the Inhabitants of Clara Island, Ireland. *Brit. Ass'n for the Adv. of Sci.*, 1897, (67), 510-511.

A study of the average height of 56 adult males giving an average of 66.75 inches.

*128. BRUMMERSTAEDT,— (Birth Measurements of Infants) *Bericht aus der Grossherzogl. Central-Hebammen-Anstalt.* Rostock: 1865, (47).

*129. BRÜNING, H. Zur Frage der Kriegsneugeborenen. *Dtsch. med. Woch.*, 1918, (44), 581.

This is a report and comment on Hoffman's Dissertation.

130. BRUNNICHE, A. Ein Beitrag zur Beurteilung der Körperentwicklung der Kinder. *Jahrb. f. Kinderkrankh.*, 1866, (47), 1-28.

131. BRUNN,— Hygiejniske og anthropometriske Undersögelser i Esbjerg. *Hygiejniske meddelelser,* 1887, 19.

132. BRYAN, E. B. Nascent Stages and Their Pedagogical Significance. *Ped. Sem.*, 1900, (7), 357-396.

This is one of the important articles on physical growth from the standpoint of periods of development. The author bases his conclusions on the work of thirty-seven different writers. After outlining the periods of childhood as differentiated by Hartwell, Lange, Zeising and others, he finds there are three periods: Infancy, childhood and youth. Each of these stages is discussed from the scientific and pedagogical points of view.

133. BUFFON,— Sur l'accroissement successif des enfants; Guéneau de Montbeillard mesuré de 1759 à 1776. *Oevres complètes.* Paris: Paris: Furne et Cie., 1837, (3), 174-176.

Probably the first instance of successive measurement of a child.

134. BUFFON,— Histoire de l'homme, 11-13. *Oeuvres complètes.* Paris: 1829-1832, 29 vols.

135. BÜRGERSTEIN, L., and others. *Schulhygiene.* Jena: Fisher, 1902, 473-485.

A good summary of anthropometric work with references to American studies, including tables and curves. A short list of references is included.

136. BURK, F. Growth of Children in Height and Weight. *Amer. J. Psychol.*, 1898, (9), 253-326.

This is the most general American contribution to the subject of physical growth up to the year 1898. Most of the significant contributions previous to this are discussed and a number of tables included. Probably the most important single discussion is the series of norms derived from a comparative study of the work of Boas, Bowditch, Porter and others.

137. BURK, F. The Influence of Sex upon Growth. *Amer. Phys. Educ. Rev.*, 1899, (4), 340-349.

The conclusions of this report emphasize the fact that exercise should follow racial habit as far as possible.

138. BURK, F. Influence of Exercise upon Growth. *Rep. of Nat. Educ. Ass'n. of the U. S.*, 1899, 1067-1076.

A general account of the effect of physical exercise on growth.

139. BUSCHAN, G. Das Wachstum und seine Gesetze. *Menschenkunde.* Stuttgart: Strecker und Schroeder, 1909, 68-93.
A general treatise with several tables.

140. BUSK, R. W. Vital Index in Development. *Ped. Sem.*, 1917, (24), 1-18.
Historical sketch quoting Porter, Smedley and Baldwin and stating the fact that mental and physical development go hand in hand. Contains comparisons between normal, accelerated, and retarded children in height, weight, and vital capacity from statistics obtained from Colorado school children and those of Smedley from the John Worthy School, Chicago.

*141. BYFIELD, A. H. AND DANIELS, A. L. The Antineuritic and Growth Stimulating Properties of Orange Juice. *Amer. J. Dis. Child*, 1920, (19), 349-358.
Five charts show the favorable effect on the weight of babies and of animals of a diet containing orange juice.

142. CAILLI, A. Étude sur les variations de poids observées chez les enfants envoyés à la Montague. *Bull. méd.*, 1903, (17), 849-851.
This contains curves constructed from the weights of 914 children, 3 to 14 years old, who had been sent to the country from city homes. The graphs show the beneficial influence of country living.

143. CAMERER, W. Untersuchungen über den Verlauf des Längen- und Gewichtswachstums und deren Beziehungen bei chronischer Unterernährung. *Württemb. ärtzl. Korrespondenzbl.*, (76), 1016.

*144. CAMERER, W. Bemerkungen über Wachstum. *Zsch. f. Biolog.*, 1880, 24-28.
A short, detailed study of infant growth which was reprinted in *Jahrb. f. Kinderheilk.*, 1893, (36), 249-293.

*145. CAMERER, W. sen. Gewichtzunahme von 21 Kindern im ersten Lebensjahre. *Jahrb. f. Kinderheilk.*, 1882, (18), 254-264.
This contains an extension of the measurements of two of Vierordt's cases with data on 12 new cases. It also gives references for Vierordt's 29 cases collected from the literature and published together with nine of Vierordt's own in his two editions of *Kindsphysiologie*. For Camerer's own cases, data are given in regard to feeding, illness, etc. The article is interesting historically, but the norms could scarcely be used for healthy infants.

146. CAMERER, W. sen. *Das Gewichts- und Längenwachstum des Menschen.* Leipzig: 1893.

*147. CAMERER, W. Untersuchungen über Massenwachstum und Längenwachstum der Kinder. *Jahrb. d. Kinderheilk.*, 1893, (36), 249-293.
This article begins with a critical discussion of previous work and then presents data included for the most part in the later article (*Jahrb. f. Kinderheilk.*, 1901, (53). 381-446.). For the first year of life Camerer finds the usual phenomena. He believes that the retardation in growth at the end of the third quarter is to be ascribed to dentition. He corroborates Malling-Hansen's work on seasonal variations.

*148. CAMERER, W. sen. Das Gewichts- und Längenwachstum des Menschen insbesondere im 1 Lebensjahr. *Jahrb. f. Kinderheilk.*, 1901, (53), 381-446.
This contains (including data previously published) the original tables for 119 breast fed infants and 84 artificially fed infants, each measured weekly to the end of the first year, and

also some data for the second year on 27 children. This material is analyzed in numerous tables and graphs.

149. CAMERER, W. Gewichts und Längenwachstum der Kinder. *Med. Cor. Bl. d. Würtemburg ärztl. Ver.*, 1905, (75), 454-464.

*150. CAMERER, W. jun. *Verhandlungen der Gesellschaft für Kinderheilkunde.* München; 1899, 1.
Contains the average weights for 283 cases.

151. CAMERER, W. Jun. Untersuchungen über das Längen- und Gewichtswachstum bei chronischer Unterernährung. *Verhandl. d. Gesellsch. f. Kinderheilk. in Meran.*, 1905.

*152. CAMERER, W. jun. Children's Growth in Weight and Height. In Pfaundler and Schlossmann's *Diseases of Children.* Philadelphia: Lippincott & Co., 1908, (1), 414-429.
This is a chapter in the English translation of Pfaundler and Schlossmann's *Handbuch der Kinderheilkunde.* It is a good general article with a large number of excellent colored charts.

*153. CAMERER, W. AND HARTMANN, O. Der Stoffwechsel eines Kindes in ersten Lebensjahre. *Zsch. f. Biolog.*, 1878, (14), 383-414.
This contains very exact data on the metabolism and weight of an infant. Determinations were calculated or actually made for every day of the first year.

154. CAMESCASSE, J. E. L. Étude statistique sur l'évolution du pois des enfants de Paris entre quatre ans et quinze ans sur les documents réunis a l'hôpital de Forges-les-Bains (A. P.) de 1904 à 1914. *Archiv. de Méd. d. enf.*, 1918, (21), 113-149. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 1194.
This article analyzes the data of a rural sanitarium and orphan asylum for Paris children. The weight of 2571 boys and 2506 girls was taken at regular monthly intervals. Diagrams are constructed to show normal weight at different ages.

155. CAMESCASSE, J. E. L. Effet de restrictions alimentaires sur l'évolution du poids des enfants à Forges. *Rev.-d'hyg.*, 1918, (40), 372-382.
This article deals with an experiment in which, for the sake of economy, bread was replaced by rice and vegetables. The effect upon growth was good, which is not surprising in view of the greater variety in diet.

156. CAMESCASSE, J. E. L. Lois de l'accroissement en pois des enfants; effet des restrictions alimentaires actuelles. *Rev. d'hyg.*, 1918, (40), 337-361.
This article deals with the same experiment as that mentioned in the former reference.

157. CAMPUS, P. *Oeuvres de P. Camper qui ont pour objet l'histoire naturelle, la physiologie et l'anatomie.* Paris: 1803, 3 vols.
Cited for its historical value.

158. CARLIER, G. Des rapports de la taille avec le bienêtre. Recherches anthropologiques sur la croissance. *Mém. Soc. anthropol.*, 1892, (4), 2nd series, 265.

159. CARMON, W. B. Causes of Some Rapid Changes in Body Weight. *J. Amer. Med. Ass'n.*, 1912, (59), 725-771.
A brief discussion of theoretical value.

160. CARSTAEDT, C. Über das Wachstum der Knaben vom 6 bis zum 16 Lebensjahre. *Zsch. f. Schulgesundheitspf.*, 1888, (1), 65-69.
The article contains two valuable tables for comparative purposes. In one, the height of 4274 boys from 6 to 6½ years (in half yearly measurements) is given; in the other, the maxima and minima of height for the same ages are recorded. The measurements were taken in a "Höhere Bürgerschule" in Breslau.

161. CARUS, C. G. *Die Proportionslehre der menschlichen Gestalt, zum ersten Male morphologisch und physiologisch begründet.* Leipzig: 1854.
Interesting historically.

162. CASSENILLI, L. R. (Development of School Children). *Semana Med.*, 1917, (24), 437. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 579.
Herein are reported the average height, weight, antero-posterior diameter of chest and vital capacity of 1000 Argentine boys and girls, 14 to 16 years.

163. CATTELL, J. AND FARRAND, L. Physical and Mental Measurements of the Students of Columbia University. *Psychol. Rev.*, 1896, (3), 618-648.
A detailed study of mental tests and physical characteristics with some suggestions on anthropometric measurements.

*164. CHAILLE, S. E. Infants; Their Chronological Progress. *New Orleans Med. & Surg. J.*, 1886-87, (14), 893-912.
This report contains a few measurements and many suggestions for observation.

165. CHAMBERLAIN, A. F. *The Child.* New York: Scribner, 1900, 51-106.
A general discussion of the problem of physical growth from the anthropological and educational standpoints.

166. CHAUMET, E. *Recherches sur la croissance des enfants des écoles de Paris,* (et des crèches, dispensaires et consultations extérieurs des hôpitaux). Paris: 1906, (60), 80.

167. CHERVIN, A. Anthropométrie militaire. *J. Soc. de Statist. de Paris,* 1896, (37), 408-428.

168. CHILDREN'S BUREAU. *Table of Heights and Weights.* Washington: U. S. Dep. of Labor, 1918.
This is a convenient table of measurements at three months, six-48 months, and at each year from five to 16, for both boys and girls. The norms are taken from Holt, Crum and Bowditch.

169. CHOSE,— *Über den Einfluss durchgemachter Rachitis auf die Körpermasse von Schulkindern.* Diss. München: Müller & Steinicke, 1914.

*170. CHRISTOFFERSEN, W. Spaedbarns vaegt og laengde forögelse, (The Weight and Height of New-born Infants). *Tidrskr. for nordisk retsmedicin og psykiatri,* Kristiania: 1905, (4), 15-17.

171. CHRISTOPHER, W. S. Measurements of Chicago Children. *J. Amer. Med. Ass'n.*, 1900, (35), 618-623; 683-687.
This is a detailed illustrated report of the work done at Chicago by Smedley, Campbell, McMillan, and others in the Chicago public schools. The charts and graphs are included in the report of Smedley, which is noted further along in this bibliography. In the second part of the report, Christopher says: "At the outset of my investigations I determined to reinvestigate Porter's proposition, and have to say that such facts as we have been able to collect go to confirm it."

*172. CLARKE, J. Observations on Some Causes of the Excess of the Mortality of Males above That of Females. *Phil. Trans.*, 1786.
Study of 20 males and 20 females, giving weight and a few height measurements.

*173. CNOPF, J. *Protocol der Verhandl. d. Generalversamml. des Ver. mittelfrank. Artzte.* Nürnberg: 1871.
Reports the weight of 13 infants.
Also *Historische Mitteilungen über die Wägungen der Neugeborenen.* Nürnberg: 1875.

174. COHN, M. Die Kenntis der Körperlänge; ein Maszstab für die normale Entwicklung der Schulkinder. *Zsch. f. Schulgesundheitspf.*, 1912, (25), 693-696.

Since year-norms previously established are very confusing because various investigators have used the word "Year" to include different month limits, the writer proposes using norms in the form of tables of measures corresponding to different types. He gives one table of data derived from 90 healthy boys six to 13 years.

175. COMBE, J. Körperlänge und Wachstum der Volksschulkinder in Lausanne. *Zsch. f. Schulgesundheitspf.*, 1896, (9), 569-589.

During the seven years of Combe's investigation 2000 children were measured, giving a sum total of 13,358 measurements. The value of individual measurements is discussed, and also the relation of disease to growth in height at different ages with reference to time of birth in year, and to parentage.

176. CONVY,— Notes anthropométriques sur quelques races du territoire militaire de l'Ichad. *Anthropologie*, 1907, (18), 549-582.

177. CORDEIRO, F. J. B. A Contribution to Anthropometry. *N. Y. Med. J.*, 1887, (45), 484-487.

An illustrated article showing the method of computing height and weight curves, with a number of conclusions and criticisms bearing on the work of other investigators, together with some data on the average maximum and minimum measurements for height, weight, chest, and chest expansion between the ages of 14 and 18 for sailors on the *Minnesota*.

*178. COUDREAU,— *Recherches sur l'alimentation des enfants.* Paris: 1869.

Reports the weight of two infants.

179. COURTIS, S. A. Measurement of the Relation Between Physical and Mental Growth. *Am. Phys. Educ. Rev.*, 1917, (22), 464-481.

An address with 15 graphs, showing the relation between growth in height, weight, lung capacity and grip and mental development, as shown by certain tests. The writer believes that children who are poorly developed physically are also dull mentally, and that physical exercise will accelerate mental development.

180. CRAIG, J. I. Anthropometry of Modern Egyptians. *Biometrika*, 1911-12, (8), 66-78.

Stature, head and other measurements from the same material as that analyzed by Orenstein.

181. CRAMPTON, C. W. Anatomical or Physiological Age versus Chronological Age. *Ped. Sem.*, 1908, (15), 230-237.

A general discussion of the previous work done in this field by the writer and a recommendation that "All observations, records, and investigations of children, whether pedagogical or medical, social or ethical, must regard physiological age as a primary and fundamental basis."

182. CRAMPTON, C. W. Influence of Physical Age on Scholarship. *Psychol. Clinic*, 1908, (1), 115-120.

In this article Crampton discusses the relation of physiological age, as determined by pubescence and height, to "scholarship". The tables are confined to boys (?) between the ages of 12 and 17 years. The conclusion are that "earlier pubescence favors good scholarship; later pubescence poor scholarship."

183. CRAMPTON, C. W. Physiological Age. *Amer. Phys. Educ. Rev.*, 1908, (13), 144-154; 214-227; 268-283; 345-358.

One of the best studies so far made on the age of puberty in boys. The age at which this usually takes place is from 13.5

to 14.5. "Individuals differ from each other in weight (and height) according to their maturity." There is, according to these results, no marked primary relation between scholarship and weight, height, strength, etc.

184. CRAMPTON, C. W. *The Significance of Physiological Age in Education.* Washington: Gov. Print. Off., 1913. Pp. 13. Repr. f. *Trans. of 15th Int. Congr. on Hyg. and Demogr.*

This pamphlet contains some tables for the physical development of pubescent boys with pedagogical and social recommendations.

*185. CRUM, F. S. Anthropometric Table. Chicago: *Amer. Med. Ass'n.* No date; about 1915.

Measurements are given for 10,423 male and female children, six-48 months old, in 31 states. Height, weight, circumference of head, chest and abdomen, diameter of chest, and length of arm and leg are included. These are not original measurements but a compilation from various American sources.

186. CURTISS, F. H. Some Investigations Regarding Loss in Weight and Gain in Height during Sleep. *Am. Phys. Educ. Rev.*, 1898, (3), 270.

187. DAAE, A. AND DAAE, H. Sur la taille, l'envergure, le périmètre thoracique et la hauteur du buste chez les populations de l'intérieur et des côtes de la Norvège. *Bull. et mém. soc. d'anthropol. de Paris*, 1906, 5 S., (7), 158-164.

188. DAAE, H. Die Körpergrösse des norwegischen Volkes. *Norsk. Mag. f. Laegevid.*, No. 7. Cited in *Dtsch. med. Woch.*, 1909, 1281.

189. DAAE, H. Om det Norske Folks Legemshöide. *Norsk. Mag. f. Laegevidensk.*, 1909, 606.

190. DAFFNER, F. Vergleichende Untersuchungen über die Entwicklung der Körpergrösse und Kopfumfanges. *Archiv f. Anthropol.*, 1884, (15), 37-44.

A good discussion of the subject, including many tables.

191. DAFFNER, F. Über Grösse, Gewicht, Kopf und Brustumfang beim männlichen Individuum vom 13 bis 22 Lebensjahre. *Archiv f. Anthropol.*, (Beilage), 1884, (15), 121-126.

Supplementary to the preceding study but confined to males and including chest circumference. A small number of individuals is included; each year from 13 to 22 is taken up separately.

192. DAFFNER, F. Data on Measurements of 6000 California School Children as to Weight and Measurement. *Oakland Sch. Rep.*, 1892-93. See Barnes.

193. DAFFNER, F. *Das Wachstum des Menschen. Anthropologische Studien.* Leipzig: Engelmann, 1902. Pp. 475.

A good study of growth of different parts of the body, starting with the embryo and including puberty.

194. DALLY,— Proportions et croissance relative des membres. *Bull. soc. anthrop.*, 1872. 832.

*195. DANIELS, A. L. AND BYFIELD, A. H. The Role of the Antineuritic Vitamin in the Artificial Feeding of Children. *Amer. J. Dis. Child.*, 1919, (18), 546-554.

This contains seven graphs showing the growth of individual infants. The addition of the antineuritic vitamin to the diet of babies supplied with food containing an adequate number of calories stimulates growth.

196. DANSON, J. T. Statistical Observations Relative to the Growth of the Human Body (Males) in Height and Weight, from 18 to

30 years of Age, as Illustrated by the Records of the Borough Gaol of Liverpool. *Jour. Stat. Soc.*, 1862, (25), 20.
A study of the physical measurements of 4800 prisoners.

197. DAVENPORT, C. B. *Statistical Methods with Special Reference to Biological Variation.* New York: Wiley, 1899. Pp. 148.
A good treatment of methods applicable to the subject.

198. DAVENPORT, C. B. *Heredity in Relation to Eugenics.* N. Y.: Holt & Co., 1911. Pp. 298.
This book contains numerous charts and illustrations of the inheritance of physical as well as other characteristics.

199. DAVENPORT, C. B. Inheritance of Stature. *Genetics*, 1917, (2), 313-389.
This investigation reprinted as Bull. No. 18 of the Eugenics Record Office at Cold Spring Harbor, N. Y. contains an empirical field study and questionary on the inheritance of total stature and segments of stature, with supplementary data on a few special classes including dwarfs and giants. The outstanding conclusions are "that persons of similar stature tend to marry each other. When both parents are tall and of tall stock, practically all of the children are tall or very tall." The opposite of this is also true.

199a DAVENPORT, C. B. The Best Index of Build. *Pub. Amer. Stat. Ass'n.* 1920, (17), 341-344. Also *Amer. J. Phys. Anthrop.*, 1920, (3), No. 4.
Concludes: "The best index of build is the weight divided by the square of the height."

200. DAVENPORT, C. B. AND LOVE, A. G. Defects Found in Drafted Men. *Sci. Mo.*, Jan. 1920, 5-25; Feb. 1920, 125-141.
This is a brief report on defects revealed in the medical examination before local draft boards and in training camps. Numerous graphs show the distribution of physical defects in various parts of the United States. Of special interest is the incidence of deficient measurement, underweight and underheight.

201. DAVID, F. A. *Proportions des plus belles figures de l'antiquité, avec figures accompagnées de leur description par Winckelmann.* Paris: 1798.
Included on account of its historical significance.

202. DAVIDSOHN, H. Die Wirkung der Aushungerung Deutschlands auf die Berliner Kinder. *Zsch. f. Kinderheilk.*, 1920, (21).
Found a considerable decrease in weight and height of Berlin children as a result of war conditions.

203. DEBUSK, B. W. Height, Weight, Vital Capacity and Retardation. *Ped. Sem.*, 1913, (20), 89-92.
A brief preliminary study of physical development.

204. DEMENTIEW,— *(The Development of Muscular Force in Man.)* Thesis. Moscow: 1889.
Russian, cited by Wiazemsky. Contains measurements of height.

205. DEVRAIGNE, L. L'enfant dans les premières années (observations anatomiques et physiologiques.) *Rev. mens. de gynec., d'obstét. et de pédiat.*, 1914, (9), 166-176.

206. DICK, J. L. *Defective Housing and the Growth of Children.* London: Allen and Unwin, 1919.
This is a study of 2000 Jewish and Christian children from the slums of London. Eighty percent were found to bear the stigmata of rickets due primarily to deprivation of fresh air, sun-

light and exercise, which profoundly alters the metabolism of the child.

207. DICKSON, S. H. Statistics of Height and Weight in the South. *Charleston Med. J. & Rev.*, 1857, (12), 607-613.

Dickson has collected in this report some detailed statistics in regard to the average height and weight of Southern men.

208. DICKSON, S. H. Some Additional Statistics of Height and Weight. *Charleston Med. J. & Rev.*, 1858, (13), 494-506.

In this report a comparison is made between the heights and weight of Americans of different nationalities with the stature and weight of Europeans. Results are based on students of the Medical College of South Carolina, the University of Louisiana, the University of Tennessee, Jefferson College, Virginia Military Institute, the Michigan Academy at West Point, and the University of Michigan. Conclusions show that Europeans increase more in weight than Americans as they grow older. The Americans have on the average greater height.

209. DICKSON, S. H. Statistics of Height and Weight. *Amer. J. of Med. Sci.*, Philadelphia: 1866, (52), 373-380.

This report shows that the new American race, which is growing out of an almost unlimited mixture of other races, exhibits thus far no deterioration, but compares favorably with all the races of the Old World in every point of physical development.

210. DIEK,— Materali k izsledovaniyi roste, viesa, okruzhnosti grundi i zhiznennoo yomkosti lishkickh detskavo i yunoshesk. *Voyenno-med. J.*, 1883, (146), 223-363.

A report of the stature, weight and vital capacity of children in Russia. An inaugural dissertation given in St. Petersburg, cited by Sack.

211. DIKANSKI, M. *Über den Einfluss der sozialen Lage auf die Körpermasse von Schulkindern.* München: Müller & Steinicke, 1914. Pp. 25.

Measurements supplied by Hoesch-Ernst of height and weight of 1843 girls 6-7 years of age are classified according to three social grades. From the averages alone, one would conclude that better social environment is correlated with better physical growth. Since the variations about the mean are greater with rising social class, this conclusion becomes less significant. A comparative table is given for the 10 other investigations.

212. DOLL, E. A. *Anthropometry as an Aid to Mental Diagnosis.* (Public. No. 8 of the Training School). Vineland: 1916. Pp. 99.

This is a study of three physical measurements (height, sitting-height and weight) and three psycho-physical measurements (right and left grip and vital capacity) of 141 girls and 336 boys in an institution for the feebleminded. These measurements are classified according to the mental age of the subjects and compared with the Smedley percentile tables. In all these measurements the feebleminded were found to be below the normal. The writer believes that he has discovered a diagnostic criterion of feeblemindedness in the slope of the line connecting the average of the three physical with the average of the three psycho-physical measurements.

213. DONALDSON, H. H. *Growth of the Brain.* London: 1896. Pp. 369.

Chapters II and III are very good on the general problem of physical growth.

214. DONALDSON, H. H. *A Comparison of the White Rat with Man in Respect to the Growth of the Entire Body.* Lancaster, Pa.: New Era Co., 1906. Pp. 26.

An important comparison between the growth in body weight of the rat for 365 days, and of man from birth to 23 years of age, the latter being based on Robert's tables. The conclusions reached are that "the increase in body-weight of the man and the white rat between conception and maturity exhibit similar phases, five in number."

215. DONALDSON, H. H. Physical Growth and School Progress. *Psychol. Bull.*, 1915, (12), 360-363.
A review and discussion of the contributions to research in physical growth made in B. T. Baldwin's book of the same name.

216. DOTCHEFF, A. *Poids des enfants des écoles primaires de Lausanne.* Lausanne: 1901.

217. DOWNES, R. M. The Interrelationship of some Trunk Measurements and Their Relation to Stature. *J. Anat. and Physiol.*. 1913-14, (48), 299-314.
Measurements of six diameters were made on 201 cases, six months to 90 years of age. Tables of the relationships of indices are calculated from these measures. Females showed a greater range of variation.

218. DRONTSCHILOW, K. Die Körpergrösse der burgärischen Rekruten und ihre Verteilung in den einzelen Distrikten. *Arch. f. Anthropol.*, 1914, n. f. (13), 337-341.
A study of 175,437 subjects, with tables of measurements.

219. DRONTSCHILOW, K. Beiträge zur Anthropologie der Bulgaren. *Arch. f. Anthropol.*, 1915, n. f. (14), 1-76.
A study of 15 measurements of the head on 601 subjects, ages 20 to 52. Many graphs and tables.

220. DU BOIS,— AND DU BOIS,— Measurement of the Surface Area of Man. *Arch. of Intern. Med.*, 1915, (15), 868.
Develops a linear formula for body surface.

221. DU BOIS,— AND DU BOIS,— A Formula to Estimate the Approximate Surface if Height and Weight be Known. *Arch. of Intern. Med.*, 1916, (17), 863.

222. DUBOIS,— Le poids et la taille des enfants 6 à 7 ans à Liége en 1918. *Bull. Acad. roy. de méd. de Belg.*, 1919, 4 s., (29), 1568-1594. 5ch. [Rapp. de Demoor], 1498-1500.

223. DUDREWICZ, L. Pomiary anthropolog. dzieci Warszawskich. *Zboir. wiad. do anthrop.....*Akad. Umiej. w. Krakow, 1882, (6), 3-23.
Anthropological measurements of children in Warsaw.

224. DUFESTEL, L. Des mensurations anthropométriques chez l'enfant. *Pédiatrie prat.*, 1907, (5), 193-198.

225. DUN, W. A. The Police Standard of Cincinnati; with Some Statistics Compiled from the First Thousand Examinations of Applicants. *Lancet-Clinic.*, 1887, (18), 131-135; 767-776.
Contains valuable tables for comparative study on minimum height and weight requirements.

226. DÜRER, A. Folio, Nuremberg: 1528.
Includes 4 books on human proportions.

227. ECKER, A. Zur Statistik der Körpergrösse im Grossherzogtum Baden. *Arch. f. Anthropol.*, 1876, (9).

*228. EDDY, W. H. AND ROPER, C. J. The Use of Pancreatic Vitamin in Cases of Marasmus. *Amer. J. Dis. Child.*, 1917, (14), 189-201.
Shows the effect in stimulating the growth of four infants. One curve extends to the 140th day.

229. ELDERTON, E. M. Height and Weight of School Children in Glasgow. *Biometrika*, 1914, (10), Parts 1 & 2, 288-339.
Measurements of 30,965 girls and 32,811 boys 5½-14½ years

are arranged in four classes from A, the poorest district, to D, a better district. Ages are given to the nearest year, weight to the nearest pound, and height to the nearest quarter inch. Numerous tables are given of the distribution of weight and height and two graphs for comparing the measurements of these children with the standards of the British Association Anthropometric Committee. Various regression coefficients are included.

230. ELLIOTT, E. B. On the Military Statistics of the United States of America. *U. S. Sanitary Commission*, 1863, (4), 44.

A comparatve study of the heights, weights, etc. of soldiers in the Army of the Potomac.

231. ELLIS, H. *Man and Woman.* London: 1896, 31-114. Also published by Scribner, New York: 1904, 32-54.

In Chapter III of this book there is a good discussion of the growth and proportions of the body. A number of references are given and four charts from Key showing the relative increments of growth in height and weight from seven to 20 years of age. The relative proportions of different parts of the body of man and woman are compared.

232. ELSHOLT, J. S. *Anthropometria,* sive De mutua membrorum corporis humani proportione. Padua: 1654.

This is one of the first works on anthropometry and as such is chiefly concerned with symmetry and aesthetic values. It contains pictures of the perfect body and of old anthropometric instruments. No tables.

233. ELSON, J. C. Statistics Regarding Short Course Students. *Amer. Phys. Educ. Rev.*, 1910, (15), 348-349.

A brief article which shows that in a study of 8000 college students the short course men (men who are taking special courses in agriculture) surpass in all measurements, except height, the men of the present freshman class.

234. EMERSON, W. R. P. AND MANNY, F. A. Weight and Height in Relation to Malnutrition. *Arch. of Pediat.*, 1920, (37), August.

The figures of Holt, Boas, Burk and other investigators were assembled into tables showing the weight for each inch of height from 21-68 inches for children of average weight and those underweight, and tables showing the increases in weight at various years. The article is principally interested in establishing "zones" of measurements for diagnosing nutritional condition.

235. ENEBUSKE, C. J. An Anthropometrical Study of the Effects of Gymnastic Training on American Women. *Amer. Stat. Ass'n. Papers on Anthropometry,* 1894, 47-57.

One hundred students (19-42 years of age) of the Boston Normal School of Gymnastics were measured before and after 7 months' training. The effect on height, weight, and lung capacity is shown by tables. See also Some Measurable Results of Swedish Pedagogical Gymnastics, *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1892, (7), 207-255, which contains a report of observations made by M. Aura Wood on 26 students of the Boston Normal School of Gymnastics. Eight tables are included and a plea is made for casuistic study in place of isolated statistical measurements.

236. ENGELHORN,— Über den Ernährungszustand der Schulkinder im 2. Kriegsjahr. *Zsch. f. Kinderforsch.*, 1915-16, (21), 248-250.

On the basis of 4000 examinations of school children (by the method of inspection) it was found that the children were in better condition than in peace times. This result is attributed to a more sensible diet, withdrawal of sweets, etc.

237. ENGELHORN,— Über den Ernährungszustand der Schulkinder im Kriegsjahr. *Zsch. f. Kinderforsch.*, 1916-17, (22), 64-65.
During this year 1371 children were examined. Somewhat fewer were found to be in "good" condition, more in "medium" and more in "poor" nutritional condition, among the city children. The country children were found to be in good condition.

238. ERISMANN, F. Schulhygiene auf der Jubileumsausstellung der Gesellschaft für Beförderung der Arbeitsamkeit in Moskau. *Zsch. f. Schulgesundheitpf.*, 1888, (1), 367-373; 393-419.
The latter part of this report gives comparative tables with discussions on the height and weight of about 3000 boys and 1500 girls in the schools of the city of Moscow, and 4300 boys and 700 girls in the nearby village schools.

239. ERISMANN, F. Untersuchungen über die körperliche Entwicklung der Fabrikarbeiter in Zentralrussland. *Arch. f. soz. Gesetzgeb. u. Statis.*, 1888, (1), 98. Also printed separately, Tübingen: Laupp, 1889. Pp. 96.
A detailed study of height, chest circumference, weight and muscular strength, and of the factors that influence them. The data are analyzed by occupations and races. Tables and graphs.

240. ERISMANN, F. *Untersuchungen über die körperliche Entwicklung der Arbeiterbevölkerung.* Tübingen: 1889. Reprinted from *Arch. f. soz. Gesetzgeb. u. Statis.*
The latter part of this report deals primarily with hygiene and gives the results of the measurements of 24,288 boys and 16,032 girls ranging from seven to 18 years, taken from city schools, village schools, and factories.

241. ERNST, L. H. AND MEUMANN, E. *Des Schulkind in seiner körperlichen und geistigen Entwicklung.* Leipzig: Nemnich, 1906. Pp. 143.
This book contains a fairly complete summary of the previous investigations upon physical growth and development, and a series of charts which give the growth curves as found by the different investigators. The authors' own work consists in a study of 300 Zürich children, with regard not only to height and weight but also lung capacity, span of arms and various girths. These figures are presented in detailed tables and the authors' conclusions are compared with those of previous investigators.

242. EULENBURG,— Militärsanitätswesen. *Realencyclopädie*, 1910, (12), 485.
Eulenburg tried Pignet's formula on 10,000 recruits, but found it unsuitable for individual cases.

243. EYERBISH,— AND LÖWENFELD,— *Über die Bezichung des Kopfumfanges zur Körperlänge und zur geistigen Entwicklung,* Wiesbaden: Bergmann, 1905.

*244. FABER, H. K. A Study of the Growth of Infants in San Francisco with a New Form of Weight Chart. *Arch. of Pediat.*, 1920, (37), 244.
Presents a new chart plotted from the average weights of babies in maternity hospitals and clinics. This curve is higher than the curve of Griffith.

245. FARR, W. Table Showing the Relative Stature of Boys at the Age 11 to 12, Under Different Conditions of Life. *Brit. Ass'n for the Adv. of Sci.*, 1880, (1), 128-159.
A report of the committee of the Association, appointed originally in 1875, for the purpose of continuing the collection of observations on the systematic examination of heights, weights,

etc., of the human frame in the British Empire, and the publication of photographs of the typical races of the Empire. In 1879, 46 different classes of subjects were included, giving a sum total of 11,745 individuals, while in the 1880 study one class of subjects was included, or 11,956 individuals. There are several excellent distribution tables giving the mean measurements for boys and men between 10 and 50 years, there being in all three charts (plates) and 27 tables. This is a valuable and suggestive report.

*246. FASBENDER,— (Birth Measurements of Infants). *Zsch. f. Geburtsh. u. Gynak.*, 1878, (3), 278.
Reports the fact that first-born children are shorter than later born children.

*247. FAYE, L. *Nogle undersògelser angaaende nyfödte bòrns ernaeringsforhold.* Diss. Kristiania: 1874.

248. FAYE, L. Om Legemsveksten, Saerlig hos Nordboerne. *Kristiania Videnskapsselskaps forhandl.*, 1914, 6.

*249. FAYE, L. AND VOGT,— (Birth measurements of 2,677 cases) *Norsk. Mag. f. Lägev.*, 1866.

250. FEER, E. *Lehrbuch der Kinderheilkunde.* Jena: Fischer, 1911, Pp. 741.
This book is largely a text on children's diseases, but contains some general considerations on the subject of growth.

251. FERGUS, W. AND RODWELL, G. F. On a Series of Measurements for Statistical Purposes, Recently Made at Marlborough College. *J. Anthropol. Inst. of G. Brit. and Ire.*, 1874, (5), 126-130.
A short study of the college student.

252. FERI, C. Note sur le rapport de la longueur du tronc à la taille. *Anthropologie*, 1893, (4), 697.

*253. FESSER,— *Gewichts-und Làngenverhältnisse der menschlichen Früchte.* Diss. Breslau: 1873, 10-15.

*254. FLEISCHMANN, L. Über Ernährung und Körperwägungen der Neugeborenen und Säuglinge. *Wien. Klinik*, 1877, (3). 145-194.
An interesting article historically. It emphasizes the importance of weight as an index of growth and insists upon following individuals throughout the period observed, instead of making a few determinations and interpolating values according to some formula. An account of the early work is included but without references. A number of individual curves are appended and one table is given of average weights from one to twelve months.

*255. FLEISCHNER, E. C. The Relation of Weight to the Measurements of Children During the First Year. *Arch. of Pediat.*, 1906, (23), 739-760.
Five hundred children are divided rather arbitrarily into three classes: the well nourished, the fairly well nourished, and the poorly nourished. Nine tables and 12 charts are given, comparing the height, weight, circumference of head, chest and abdomen, in these three classes of infants. The conclusion is drawn that during the first year of life the primary factor in the increase of the measurements is the increase in weight, the influence of age being secondary. The curves for the three classes run almost parallel but at different levels, which appears to be too schematic for probability. No tables of actual measurements; but increments are given.

256. FOCK, H. C. A. L. Mémoire sur les proportions du corps de l'homme. *Compt. rend. acad. d. sci. de Paris*, 1850, (30), 661.

In this paragraph without tables, the Appollo Belvedere was taken as the model for human proportions.

257. FORBES, H. O. On the Kubers of Sumatra. *J. Anthropol. Inst.*, 1884-85, (14), 121-128.
A careful study of 12 Kubers from the central part of Sumatra, including detailed measurements.

258. FORBES, J. D. On the Results of Experiments Made on the Weight, Height, and Strength of About 800 Individuals. *Brit Ass'n. for the Adv. of Sci.*, (Transactions of the section on mathematics and physics), 1836, Part 2, 38.
This is a brief report showing that these curves coincide with those of Quetelet, full growth being scarcely completed by 25 years.

259. FORSSBERG, E. (Anthropometrical Researches on a Cavalry Regiment.) *Tidskr. i. mil. Helsov.*, 1897, (22), 139-178.
Russian.

260. FOSTER, A. B. Report of Director of Physical Training. *Amer. Phys. Educ. Rev.*, 1898, (3), 44-53.
Reprinted from the annual report of the president of Bryn Mawr College, containing measurements on freshmen, sophomores, juniors and seniors, and discussing various kinds of physical exercise.

261. FOSTER, W. L. Physiological Age as a Basis for Classification of Pupils Entering High Schools, and Relation of Pubescence to Height. *Psychol. Clinic*, 1910-11, (4), 83-88.
A study of the physiological age of 459 boys with the conclusions that there is a close relationship between height and pubescence, and that a classification of high-school students according to physiological age, based upon pubescence, is easy and practical.

262. FOURMANN, F. *Woven is das Gewicht der Neurgeborenen abhängig?* Diss. Bonn: 1901.

263. FRANKEL, L. K. AND DUBLIN, L. I. *Heights and Weights of N. Y. City Children 14-16 Years of Age.* N. Y.: Metropolitan Life Ins. Co., 1916. Pp. 53.
This is a thorough analysis with 20 tables, and 11 graphs of the data obtained by measuring the height and weight of 10,043 children who received employment certificates in New York City in 1915.

*264. FREEMAN, R. G. Weights and Measurements of Infant Children in Private Practice Compared with Institution Children and School Children. *Trans. Amer. Pediat. Soc.*, 1914, (26), 203-210.
The weight and height of 120 especially well-cared for infants, 1-12 months, are compared in graphs with the measurements of 1000 orphan asylum infants and with the norms of Holt and Camerer. Comparative graphs are also given for 278 well cared for children, 1-13 years, 1000 orphan asylum children and 98,000 school children. Children under good medical control were found to be superior in physical development.

265. FRENCH, M. S. *Report of the Physical Examination of Men upon the Police Force of Philadelphia, and Those who were Applicants for Appointment.* Philadelphia: 1885.

*266. FREUND, W. Zur Pathologie des Längenwachstums bei Säuglingen und über das Wachstum debiler Kinder. *Jahrb. f. Kinderheilk.*, 1909, (70), 752-773.
Herein are presented the growth curves of 36 infants for the greater part of a year. Fourteen graphs are given comparing pathological growth processes with the norms of Schmid-Mon-

nard. In some diseased conditions (especially short, acute infections) there was little distortion of the growth curve of height, although weight was much affected. Under other conditions the height curve failed to rise for a considerable period.

267. FRIEDENTHAL, H. Über das Wachstum des menschlichen Körpergewichtes in den verschiedenen Lebensaltern und über die Volumenmessung von Lebewesen. *Mediz. Klinik,* 1909, (5), No. 19, 700-703.
Comparative curves are given for growth in weight of man and the other mammals, showing a great similarity, especially between man and the anthropoid ape.

268. FRIEDENTHAL, H. Daten und Tabellen betreffend die Gewichtszunahme des Menschen und anderer Tierarten. *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 221-274.
Consists largely of tables and graphs comparing man and animals.

269. FRIEDENTHAL, H. Das Wachstum des Körpergewichts der Menschen und anderer Saugetiere in verschiedenen Lebensaltern. *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 49-73.
Further data on the growth curves of man and animals, with numerous tables.

*270. FRIEDENTHAL, H. Das Wachstum menschlichen Säuglinge in den ersten Monaten nach der Geburt. *Verhandl. d. physiol. Gesellsch. zu Berl.,* 1911, (35), 75-78.

271. FRIEDENTHAL, H. Über das Wachstum des menschlichen Körpergewichts in den verschiedenen Lebensaltern und über die Volumenmessung von Lebenwesen. In *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 40-48.
Further comparisons of growth in man and animals, with two charts.

272. FRIEDENTHAL, H. Experimentelle Prüfung der bisher aufgestellen Wachstumsgesetze. In *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 76-82.
Discussion of the curve of growth in man and animals. The writer finds it impossible to formulate a general law of growth at this time.

273. FRIEDENTHAL, H. Über Wachstum. *Ergebn. d. inn. Med. u. Kinderheilk.,* 1912, (8), 254-299; (9) 505-530; 1913, (11), 685-753.
Part I is a physiological introduction.
Part II gives comparative tables of weight from Camerer, Quetelet, Landois, Beneke, Roberts, with much original material.
Part III gives similar tables for height and other physical measurements with drawings of the human body to show where the measurements are taken.

274. FRIEDENTHAL, H. *Allgemeine und spezielle Physiologie des Menschenwachstums.* Berlin: Springer, 1914. Pp. 161.
A scientific presentation of the physiological and anthropometric work on growth. It includes sections on the chemistry and physics of organic growth, comparison of growth in man and other higher organisms, tables of measurements of height and weight increase in fetal and post-natal life, and of the proportions of the human body. Some of the material in this book has been included in previous articles. The writer mentions as his chief theses: 1st, no "growth energy" can be calculated from

the caloric value of the nourishment taken in by the individual; 2nd, the physiological comparison of new-born individuals from the different zoological, mammalian orders is unreliable; 3rd, conclusions as to the speed of growth should be derived not from the weight curves but from the increment curve; 4th, age is to be calculated from conception rather than from birth.

275. FRÖHLICH, H. Die menschliche Körperlänge. *Allgemein. med. Centralzeit.*, 1896, (65), 69-70; 82-83; 94-95; 107; 119-120; 132-133; 144-145; 156-157.
This is a survey of previous work on physical growth, the effect of climate, racial differences in development, military anthropometry, and the effect of social status and occupation. No tables.

*276. FUCHS, K. *Die Abhängigkeit des Geburtsgewichts der Neugeborenen vom Stand und der Beschäftigung der Mutter.* Diss., Halle; 1899.

*277. FUHRMANN, F. Einiges über die Gewichtkurven der Neugeborenen. *Med. Klinik*, 1907, 510.

278. GAERTNER, G. Körpergewicht und Körperlänge des Menschen. *Wien. med. Woch.*, 1912, (62), 317-322.
A general discussion of the formulae used to express the relation of height and weight. A table is given for the normal weight of men and women for each centimeter increase of height. This table, worked out by the writer's formula, is based on the assumption that the 25 year old man of 170 cm. should weigh 70 kgm. and that the 25 year old woman of 165 cm. should weigh 60 kgm.

279. GALTON, F. On the Height and Weight of Boys, Aged 14 Years, in Town and County Public Schools. *J. Anthropol. Inst.*, 1873-74, (3), 308-311.
Comparisons are made between 509 city boys, 296 country boys and others ranging from 10 to 17 years of age: it is found that the country boys are about 1¼ inches taller and 7 pounds heavier than the city boys.

280. GALTON, F. Report of the Anthropometric Committee. *Brit. Ass'n. for the Adv. of Sci.*, 1881, (51), 225-272.
This is an early report of the committee appointed in 1875. It contains numerous tables with especially valuable statistics of height and weight.

281. GALTON, F. Report of the Anthropometric Committee. *Brit. Ass'n. for the Adv. of Sci.*, 1883.
This is the final report of the committee appointed in 1875 and includes valuable data on the growth of boys and girls at birth and during subsequent ages, including adult life. While this report deals with adults primarily, the height and weight at birth of 451 boys and 466 girls are included.

282. GALTON, F. An Anthropometrical Laboratory. *J. Anthropol. Instit.*, 1884-85, (14), 205-221.
A description of the anthropometrical laboratory, which aimed to show to the public the simplicity of the instruments and methods by which the chief physical characteristics may be measured and recorded.

283. GALTON, F. Anthropometric Percentiles. *Nature*, 1884-85, (31), 223.
In this article Galton gives a percentile table of the persons measured in the anthropometric laboratory at the late international health exhibit. The table is given primarily as a sample of the statistical method, and secondarily for its intrinsic value.

There were in all 9337 persons measured between the ages of 23 and 50.

284. Galton, F. Some Results of the Anthropometrical Laboratory. *J. Anthropol. Inst.*, 1884-85, (14), 275-288.
The results of measurements on 9337 persons, 4726 adult males and 1657 adult females. Percentile tables are given.

285. Galton, F. Hereditary Stature. *J. Anthropol. Inst. of Gr. Brit. and Ire.*, 1885-86, (14), 488-499.
A short report of Galton's findings in regard to the inheritance of stature.

286. Galton, F. Family Likeness in Stature. *Proc. Roy. Soc.*, 1886, (40), 42-73.
A detailed statistical study showing the correlation between the probable stature of a child when the statures of several of his kinsmen are known. The Appendix by Dixon gives eight tables showing the relation of the adult children of the mid-parents.

287. Galton, F. Useful Anthropometry. *Amer. Ass'n for the Adv. of Phys. Educ.*, 1891, (6), 51-57.
A discussion of the means of investigating the best method of assigning marks for physical efficiency based on anthropometric tests. A study of 2000 students at Cambridge revealed conclusively, according to Galton's observations, that success in the literary examinations is in no manner connected with stature, weight, strength, or breathing capacity, and but slightly with keenness of eyesight.

*288. Ganjoux, E. Essai sur l'évolution du poids et de la taille chez l'enfant. *Annal. de méd. et chir. inf.*, 1909, (13), 37-43.
Gives the general laws of growth and the times at which a child's birth weight is doubled, tripled, etc.

289. Gardiner, C. F. and Hoagland, H. W. Growth and Development of Children in Colorado. *Trans. Amer. Climat. Ass'n.*, 1903, (19), 258-264.

290. Garson,— Report of the Committee Appointed for the Purpose of Calculating the Anthropological Measurements Taken at the Newcastle Meeting of the Association in 1889. *Brit. Ass'n. for the Adv. of Sci.*, 1890, (60), 549-552.
Measurements of standing, kneeling and sitting heights, and of length and breadth of the head are given for 81 males and 44 females.

291. Geissler, A. and Uhlitzsch, R. Die Grössenverhältnisse der Schulkinder im Schulinspektionsbezirk Freiburg. *Zsch. des könig. Sächs. statis. Bur.*, 1888, (34), 28-40.
This investigation was begun in 1866 for the purpose of fitting school desks, and is a comparative study of the boys and girls of the Freiburg Bürger Schulen and of those of the peasant classes in nearby communities. 21,173 children were in the schools, ranging from 6½ to 14½ years of age. A critical study of the arithmetical average is included.

292. Geissler, A. Messungen von Schulkindern in Gohlis-Leipzig. *Zsch. f. Schulgesundheitspf.*, 1892, (5), 249-253.
A supplementary consideration of the greater height of the favored classes, based on new data which consists of the measurements of 2806 children at the end of the summer vacation in 1889.

293. Gihon, A. L. A Study of Adolescent Growth Based on the Physical Examination of 6129 Naval Cadets and Candidates for

Appointments as Cadets and 2058 Naval Apprentices. *Rep. of the Surg. Gen. U. S. Navy.* Washington: 1880, 15-44.

294. GILBERT, J. A. Researches on the Mental and Physical Development of School Children. *Stud. f. Yale Psychol. Lab.*, 1895, (2), 40-100.

The curves charted consist of those of the growth of boys and girls for each sex separately; the mean variation for both sexes, then each sex separately.

295. GILBERT, J. A. Researches on School Children and College Students. *Univ. of Iowa Stud. in Psychol.*, 1897, (1), 1-39.

Supplementary to the previous investigation with extra data, especially on dullness and precocity. The curves for height, weight and lung capacity and for dullness and precocity are included. Tests on various mental traits are included.

296. GIUFFRIDA-RUGGERI, V. Nuovi studi sull' anthropologia dell' Africa orientale. *Arch. per l'anthropol.*, 1915, (45), 133-179.

This is a study of height, cephalic index and nasal index with one table compiled from the measurements by several authors and much bibliographical material in footnotes.

297. GODDARD, H. H. The Height and Weight of Feebleminded Children in American Institutions. *J. of Ment. & Nerv. Dis.*, 1912, (39), 217-235.

The most comprehensive study, so far published, on the growth, height and weight of feebleminded children. Four tables and seven charts are included and the data are derived from 20 institutions. Some of the conclusions are that all defectives are heavier at birth than normals; sex differences are less marked as we go down the grades; with the morons there is an arrest of growth earlier than with the normals; there is close correlation between physical growth and mental activity.

298. GODIN, P. Determination de "l'adolescent type" aux différents âges pubertaires d'apres 36,000 mensurations sur 100 sujects suivis individuellement de 13 à 18 ans. *Bull. et Mém. Soc. d. Anthropol. de Paris*, 1902, S. 5, (3), 717-718.

A résumé without tables.

299. GODIN, P. *Recherches anthropométriques sur la croissance des diverses parties du corps.* Paris: 1903. Prix Broc. Pp. 212.

Reports continuous measurements (175 items) on the same 100 pupils of a military school from the years 13½-17½. Also contains a chapter on the determination of puberty by the anthropometric method.

300. GODIN, P. Alternances des accroissements (semestriels) au cours du developpement du corps humain (dans le sexe masculin). *Soc. de biol.*, 1910, (68), 1119-1121.

A note with four graphs showing that growth from 13 to 18 years is irregular.

301. GODIN, P. Quelques conclusions de mes recherches sur la croissance chez l'homme relatives à la puberté. *Compt. rend. d. acad. d. sci. de Paris*, 1911, (153), 967-969.

General conclusions only; no tables.

302. GODIN, P. L'accroissement inégal à l'époque de la puberté et les états pathologiques qu' il peut déterminer. *Compt. rend. d. acad. d. sci. de Paris*, 1912, (155), 66-68.

Remarks about the physiological resemblance between embryonic and pubertal growth. No tables.

303. GODIN, P. *La croissance pendant l'âge scolaire.* Neuchâtel: Delachaux et Niestle, 1913. Pp. 286.

These are lectures with educational applications, on the general

facts of growth. A number of curves are appended showing the growth of parts of the body in various ages.

304. GODIN, P. Lois de croissance. *Compt. rend. d'Inst. franc. d'anthropol.*, 1913, 191-194.

This is a very brief statement of the writer's 28 laws of growth which he has mentioned in almost the same form in other places.

305. GODIN, P. Une série de lois de croissance basées sur 2,000 observations d'enfants, 300,000 mesures et 100,000 notations: 1891-1893-1914. *Compt. rend. d. acad. d. sci. de Paris*, 1914, (159), 99-102.

In this article 28 conclusions are drawn from the writer's previous work, to which he gives references.

306. GOHDE, G. Die Ernährung der Jugend während des Krieges. *Zsch. f. Schulgesundheitspf.*, 1916, (29), 338-339.

A note of the results of the examination of 913 children of Bochum, weighed every two weeks from November, 1915, to February, 1916. The children showed normal increase in weight, as did also 215 children from less well-to-do families.

*307. GOLDFELD, Z. Die Abhängigkeit der körperlichen Entwicklung Neugeborener vom Berufe der Eltern. *Zsch. f. Geburtsh. u. Gynäk.*, 1912, (72), 407-437.

This contains a good account of the literature of this phase of the subject and gives data for the weight and length of infants at birth classified according to the occupation of the father (17 headings). The children of teachers were found to be the best developed, those of day laborers least developed.

308. GOODALL, E. The Systematic Collection of Anthropological Data in Asylums. *J. of Mental Sci.*, 1898, (44), 235-240.

309. GOODALL, E. Remarks on the Anthropological Examination of Asylum Patients, with a Scheme for the Same. *Brit. Med. J.*, 1901, (2), 1240-1242.

A plan for examination to determine whether stigmata occur more frequently in the insane than in the normal.

310. GOROKHOFF, D. Y. (On the Physical Development of Children). *Vestnik. obshtsh. hig. sudeb. i. prakt. med.*, 1916, (3), 1051-1058. Russian.

311. GOULD, B. A. Investigations in the Military and Anthropological Statistics of American Soldiers. *U. S. Sanitary Commission*, N. Y.: 1869, (2). Pp. 655.

A comprehensive study of military statistics with numerous tables.

*312. GRAANBOOM, J. *De voeding van den Ziugeling.* Amsterdam: van Rossen, 1899. Pp. 98.

313. GRATSIANOFF,— *(Materials for the Investigation of Physical Development in Childhood and Youth in Relation to Heredity and to Progress in School Work.* From observations made in Arzamas, Province of Novgorod.) Diss. St. Petersburg: 1889.

314. GRAUPNER, H. Wachstumgesetze der Körperlänge nach Untersuchung von 57,000 Dresdener Schulkinder. *Ber. d. erst. Internat. Kongr. f. Schulhyg.*, 1904, (1), 421-425.

This investigation corroborates the crossing of the growth curves of boys and girls at about 10 years of age. It shows that physical development is parallel to mental development. No growth curves are given, but the data are expressed to show the percent of children of different heights who are in each school grade.

315. GRAY, F. J. Diurnal Variations in Weight. *Amer. Phys. Educ. Rev.*, 1910, (15), 6-14.
A thesis presented for bachelor's degree in physical education at the International Y. M. C. A. training school, in June, 1908. After making comparisons with the work of M. A. Burke, H. Carrell, H. Cook, B. B. Forte, C. H. Goodwin, A. Gould, and others, the writer finds that all men gain "during the season." Seasoned athletes gained less during a season of training than green athletes.

316. GREENWOOD, A. Health and Physique of School Children. *Ratan Tata Foundation*, Univ. of London, 1915.
Includes 350,000 measurements of English school children.

317. GREENWOOD, J. M. Heights and Weights of Children. *Rep. Board of Educ., Kansas City*, 1890-91. See also *Rep. Amer. Pub. Health Ass'n.*, 1892, (17), 199-204.
The chief value of this study consists in the number of measurements included.

318. GREGOR, W. Galloway Folk in Wightshire and Kirkendbrightshire. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (67), 500-503.
A comparative study of the heights of 82 men and 34 women, the height for the men averaging 68.25 inches, for the women 63 inches.

*319. GREGORY, J. Über die Gewichtsverhältnisse der Neugeborenen. *Arch. f. Gynäk.*, 1871, (2), 48-65.
The usual physiological loss is found in the case of 60 infants. No special contribution to theory is made.

*320. GRIFFITH, J. P. C. Weight in the First Two Years of Life. *N. Y. Med. J.*, 1899, (69), 292-297.
This article presents and criticizes briefly the results of previous investigations. Comparative graphs are given and also a weight chart, with a curve to represent the average growth of healthy normal infants (based principally on the data of Camerer).

*321. GRIFFITH, J. P. C. *The Care of the Baby.* Philadelphia: Saunders, 1909. Pp. 455.
A manual for mothers and nurses containing some material on physical development and a weight chart.

322. GRIFFITH, J. P. C. The Weight of Clothing and Its Relation to the Weight of the Child in First Five Years of Life. *N. Y. Med. J.*, 1917, (106), 823.
This gives tables for 104 children showing the average weight of clothing for use when children must be weighed with clothing.

*323. GRIFFITH, J. P. C. *The Diseases of Infants and Children.* Philadelphia: Saunders, 1919, (1), 19-37.
A general treatise on childrens' diseases with a section on physical development. A growth chart for children up to 2 years is given, but not the data upon which the chart has been plotted.

324. GRINEVSKI, A. (On the Physical Development of Children) Odessa: 1892. Pp. 36.
Russian.

325. GROVER, J. I. Some Measurements of Normal Children, Especially of the Leg and Arm. Some Interesting Deductions and Practicable Possibilities. *Arch. of Pediat.*, 1915, (32), 473-486.
Measurements were made (on 500 normal-appearing children) of height, weight, length of leg and arm, circumference of head and chest, and antero-postero dimension of the head. (Ages one mo. to 12¾ years). One table and 10 graphs are given and com-

parisons are made with the measurements of a Mongolian and a Cretin.

326. GRÜNBAUM, O. F. F. On the Physical Characteristics of the Inhabitants of Barrington and Foxton in Cambridgeshire. *Brit. Ass'n for the Adv. of Sci.*, 1897, (67), 505.
A comparative table showing the height of 23 males varying from 153.3 cm. to 174.4 cm.

327. GRUZDEFF, M. Y. (Natural Division of the Child's Growth According to the Four Weight Coefficients). *Russk. Vrach.*, 1912, (11), 2112-2116.
Russian.

328. GULICK, L. *Manual for Physical Measurements.* New York: International Committee of Y. M. C. A., 1892.
One of the early handbooks with pictures to illustrate the methods of taking measurements. No norms.

329. GULICK, L. The Value of Percentile Grades. *Amer. Statis. Ass'n.* (quarterly), 1893, (21), 321-331.
A detailed discussion of the theoretical significance of the percentile method of using data.

330. GULICK, L. Physical Measurements and How They are Studied. *Phys. Educ.*, 1893, (2), 140-141; 152-153; 186-191.
A series of practical suggestions on how to make, record, and study physical measurements.

331. GUNDOBIN, N. *(Die Besonderheiten des Kindesalters)* Petersburg: 1905. Pp. 450.
Russian.

332. GUNDOBIN, N. Die Besonderheiten des Kindesalteres. *Jahrb. f. Kinderheilk.*, 1907, (65), 720-732.
This article is a German translation of the first chapter of the author's book of the same title, published in Russian in 1905. The article consists of a theoretical discussion of the pathological factors influencing physical growth.

333. GUTTMANN, M. Messungen an normalen und abnormalen Kindern. *Med. f. Alle.*, 1906, (1), 266-280.

334. GUTTMANN, M. Einige Beispiele individueller körperlicher Entwicklung. *Zsch. f. Kinderheilk.*, 1915, (13), 248.

*335. HAAKE, H. Über die Gewichtsveränderung der Neugeborenen. *Monatsch. f. Geburtsk.*, 1862, (19), 339-354.
A review of the early literature, together with the result of weighing 100 infants daily for 9 days. No theory of the cause of the physiological loss.

336. HAEBERLIN, C. Über die körperliche Entwicklung von Kindern im Frieden und Krieg. *Arch. f. Kinderheilk.*, 1916, (66), 370-384.
The author has taken records for 10 years of the growth of children in Wyk (probably not the same individuals). Height, weight, chest circumference, muscular strength, haemoglobin, etc. were determined for several thousand children. Comparison of the measurements taken before and during the war show no bad influence of war conditions. The writer gives valuable comparisons on various other factors influencing physical growth. An annotated reference table of 19 titles serves as a guide for important studies of measurements during peace and war-time made previous to this investigation.

337. HADDON, A. C. On the Physical Characteristics of the Inhabitants of Barley, Herts. *Brit. Ass'n for the Adv. of Sci.*, 1897, (67), 504-505.
A number of measurements are included in this report on the observations of 15 males from Barley.

338. HAGEN, B. Die Körpergrösse chinösishcer Frauen. *Arch. f. Anthropol.* 1901, (27), 265-266.

*339. HAEHNER, H. Über die Nahrungsaufnahme des Kindes an der Mutterbrust und das Wachstum im ersten Lebensjahre. *Jahrb. f. Kinderheilk.*, 1880-1881, (15), 23-79.

Tables are given for the increase in weight of a female infant after each feeding (mother's milk exclusively up to the 23rd week) from the first to the 26th week. From these are calculated the exact amount of food taken with the resultant effect upon the growth.

340. HALL, G. S. *Adolescence.* New York: D. Appleton, 1904. Pp. 589 (Vol. 1) and 784 (Vol. 2)

A comprehensive treatise on adolescence, its psychology and its relation to physiology, anthropology, sociology, sex, crime, religion and education. Vol. 1, pp. 1-50 contains a good summary, without direct experimental data, of the problem in height and weight. The work of Boas, Burk, and Wiener is especially emphasized and the more general and interrelated problems of development are treated in a scholarly and helpful manner.

341. HALL, W. S. Changes in the Proportions of the Human Body During the Period of Growth. *J. Anthropol. Inst. of Gr. Brit. & Ire.*, 1895, (25), 21-46.

A study in growth in height of boys in Friends' schools and Haverford College ranging from 9 to 23 years of age. Many other measurements are included and some conclusions in regard to strength. There was a great homogeneity of race, nationality, and social conditions among the individuals in these schools.

*342. HALL, MRS. W. S. The First Five Hunderd Days of a Child's Life. *Child Study*, 1896-97, (2), 332-342.

Continuous measurements (25 items) of an infant at 1-12, at 15 and at 18 months. Two tables and 1 graph show that periods of accelerated growth in one dimension alternate with periods of accelerated growth in the other dimensions and that the weight varies as the product of the vertical and lateral dimensions.

*343. HAMMETT, F. S. AND MCNEILE, L. G. Concerning the Effect of Ingested Placenta on the Growth-promoting Properties of Human Milk. *Science*, N. S., 1917, (46), 345-346.

Shows the effect of the mother's ingestion of dessicated placenta in hastening the infant's recovery from the post-natal decline in weight.

*344. HAMMETT, F. S. The Relation between Growth Capacity and Weight at Birth. *Amer. J. Physiol.*, 1918, (45), 396-405.

Data are given in five tables on weight of 537 breast-fed infants of Boston, 1, 3, 5, 7, 9, 11 and 13 days after birth. The post-natal decline in weight is shown to be a function of birth weight and growth capacity to be inversely proportional to initial weight. The article contains a discussion of the factors that influence growth.

345. HANNA, D. *Anthropometric Tables Compiled from the Measurements of 1600 Women* (Oberlin students). Oberlin, O.: Dep. of Phys. Training, 1893.

An elaborate series of tables showing many comparative measurements.

346. HANSEN, S. Über die Individuellen Variationen der Körperproportionen. *Arch. f. Anthropol.*, 1891-92, (20), 321-323.

This investigation is based on 2883 cases and gives the results, in tabular and graphic form, of the relation of the length of the foot to the height of the body.

347. HANSEN, S. Om Legemsvekst og Legemshöide. *Medd. om Danmarks anthropologi,* 1907-11, (1), 205.

348. HARRINGTON, T. F. Health & Education. *Amer. Phys. Educ. Rev.,* 1910, (15), 373-388.
Contains, after a discussion on health and ventilation, a study of the weight of 763 boys and 653 girls born in Boston, whose parents were born in Boston and attended the same schools from which Bowditch secured his measurements in 1876. At the present stage of this investigation the boys are slightly lighter than those of 1876, except at 13 years of age, and the girls are heavier.

349. HARRIS, J. Decrease in Stature; Note on Medico-Actuarial Mortality Investigation. *Amer. Statis. Ass'n.,* 1920, (17), 219-221.
An analysis of data on 182,290 men and 125,016 women compiled and published by the Association of Life Insurance Medical Directors and the Actuarial Society of America, New York: 1912 (1).

350. HARTWELL, E. M. Preliminary Report on Anthropometry in the United States With Provisional List of Works Relating to Anthropometry in the United States. *Amer. Statis. Ass'n.,* 1893, (3), 554-568.
A summary and references on the work in anthropometry in this country.

351. HARTWELL, E. M. Reports on Physical Training in Boston Public Schools. *Boston, Mass. School Report,* 1894-95, 181-260.
A careful study of the relation of stature to school work.

352. HARTWELL, E. M. Bowditch's Law of Growth and What it Teaches. *Amer. Ass'n. for the Adv. of Phys. Educ.,* 1896, 23-30.
Bowditch's law of growth is as follows: "There is a prepubertal acceleration of growth in height and weight, both in males and females, followed by a postpubertal retardation in such growth; and girls when growing most rapidly, exceed boys of like age, in height and weight." It has been thought that Bowditch was the first to note this, but it was previously noted by Fahrner, who measured 1789 children for desks.

353. HASSE, E. *Beiträge zur Geschichte und Statistik des Volksschulwesens von Gohlis.* Leipzig: Dunker und Humbolt, 1891.
Reprinted from *Report of the City of Leipzig,* 1889.

354. HASTINGS, W. W. Brief Resumé of Quetelet's Treatise on Man. *Amer. Phys. Educ. Rev.,* 1898, (3), 258-269; 309-318; 366-376.
A good summary of this book, which is anthropological rather than anthropometrical in its content.

355. HASTINGS, W. W. Anthropometry Studies in Nebraska. *Amer. Phys. Educ. Rev.,* 1900, (5), 53-66. Also *J. of Nat. Educ. Ass'n. of U. S.,* 1899, 1076-1084.
In this investigation 15 measurements were made on 2500 public school children of Nebraska. Conclusions are given as to comparative weights of boys and girls, physical well-being and mental efficiency, height and nationality. Tables are given showing average height and weight, for boys and girls, for different ages and different grades.

356. HASTINGS, W. W. *A Manual for Physical Measurements.* New York: Macmillan Co., 1902. Pp. 112.
The best summary from an anthropometrical standpoint so far published. A large amount of comparative material has been

included and many practical suggestions given. A good list of references is appended.

357. HASTINGS, W. W. Health and Growth of School Children. *J. Nat. Educ. Ass'n of the U. S.*, 1903, 769-795.
A summary which first takes up the methods of ascertaining the normal periodic increase of growth, and secondly, the practical methods of comparing the individual child with this known standard.

358. HATTA, M. *Intellectual and Physical Development.* Tokyo: Maruzen Co. No date.
The 786 graduates of a Japanese "middle school" were classified in 10 grades according to examination marks. The brighter boys were found to be superior in physical development.

359 HAUSTEIN, H. Die Darstellung von Mensch und Tier durch Messung, Messchema und Zeichnung. *Zsch. f. Ethnol.*, 1916, (48), 51-62.

*360. HAVERSCHMIDT, J. Over voedeldoseering en lichaamsgewicht bij zuigelingen. *Nederl. Tijdschr. v. Geneesk.*, 1917, (1), 1323-1326.

*361. HECKER,— Über Gewicht und Länge der Neugeborenen Kinder im Verhältnis zum Alter der Mutter. *Monatsch. f. Geburtsk.*, 1865, (26).

*362. HECKER,— (Birth Measurements of Infants) *Monatsch. f. Geburtsk. u. Frauenkrankh.*, 1866, (27), 286.
Reports length of München infants.

*363. HEIDEMANN,— *Über Gewichtsschwankungen Neugeborener. Diss.* Heidelberg, 1910.

364. HELLER, R. Untersuchungen über die Wachstumsverhältnisse der männlichen Jugend in Salzburg. *Internat. Arch. f. Schulhyg.*, 1913-14, (9), 377-388.
Investigations made upon 2400 pupils in various kinds of schools show a wide diversity of growth conditions. Children who had taken part in school outings or had spent a month in a country home were found to be much improved physically.

365. HENSEN, V. Das Wachstum. *Hermann's Handb. d. Physiol.*, Leipzig: 1881, (6), Part 2, 259-269.
A general treatise on growth with numerous tables from Quetelet.

366. HERGEL, G. Was ist auf den Gebiete der körperlichen Ausbildung unserer Mittelschuljugend Erreichbar? *Zsch. f. Schulgesundheitspfl.*, 1897, (10), 333-334.
A brief discussion leading to other papers on physical training.

*367. HERMAN, C. One Hundred Infants Followed from Birth to the End of the First Year. *Arch. of Pediat.*, 1913, (30), 97-110.
Eight curves show the effect of various feeding conditions of individual infants during the first year. No average growth charts.

368. HERTEL, A. *Report of the Danish Commission.* 1882.
This report takes up age, length of work, time at home and school, height, weight, and the common diseases, and a comparison is made between the pupils in the higher and in the Volkschulen. 17,595 boys and 11,646 girls were included, both in Copenhagen and in the country.

369. HERTEL, A. *Overpressure in High Schools of Denmark.* Tr. by Godfrey Sorenson. New York: Macmillan Co., 1885.
This is an English translation of Hertel's book which discusses the question of growth and prevalence of chronic diseases among children of different ages.

370. HERTEL, A. Neuere Untersuchungen über den allgemeinen Gesundheitszustand der Schüler und Schülerinnen. *Zsch. f. Schulgesundheitspfl.*, 1888, (1), 167-183; 201-215.

A comparison is made between age, height, and diseases of children betwen the ages of six and 17 as shown by Hertel's report, a report of the Danish Commission and a report of the Swedish commission. The emphasis in the article is placed on the relation of disease to physiological growth.

371. HERTZ,— Köbenhavnske Kommuneskolebörns Vekstforhold. *Medd. Danm. Anthrop.*, 1907-11, (1).

372. HERZOG,— Das Gewicht unserer Kriegskinder. *Kinder-Arzt*, 1916, (27), 167-169.

Comparing the years 1912 and 1915-16, the author finds that in 1912 56.09% of the cases exceeded the average weight of their age, while in 1915-16 58.02% did so. War children were also better developed all during the first year. The author thinks this is due to social hygiene.

*373. HESS, A. F. Infantile Scurvy. *Amer. J. Dis. Child.*, 1917, (14), 98-109.

Nine charts show weight in various conditions of the disease with various antiscorbutic diets. Other articles along this line in *J. Amer. Med. Ass'n.*, 1915, (75), 1003; *Amer. J. Dis. Child.*, 1916, (12), 152.

*374. HESS, W. Bestimmungen des Gewichtes und Messungen der Körperlänge bei einem Kinde im ersten und zweiten Lebensjahre. *Arch. f. Gynàk.*, 1881, (17), 150-152.

This consists merely of a table of weights (weekly, in most cases). Only a few determinations of height were made.

*375. HEUBNER, O. Wachstum des Kindes. In *Lehrb. d. Kinderheilk.* Leipzig: Barth, 1911, (1), 1-12.

This is a general treatise on growth with several tables of norms from Camerer and other writers.

*376. HILLENBERG,— Betrachungen über den Einfluss der natürlichen und künstlichen Ernährung auf die körperlièhe Entwicklung der Säuglinge im Stadt- und Landkreis Zeitz. *Zsch. f. Säuglingsfürsorge*, 1912-13, (6), 157-169.

No very significant differences in the development of breast fed and bottle fed children were observed. Whatever advantage there is is on the side of the breast fed children in the city and the bottle fed in the country, where breast fed children are apt to be irregularly fed because their mothers are working in the fields.

*377. HIRSCH,— Die "physiologische" Gewichtsabnahme der Neugeborenen. *Berl. klin. Woch.*, 1910, 11.

378. HITCHCOCK, E. The Need of Anthropometry. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1887, (3), 3-8.

A discussion of the history of anthropometry, together with suggestions on how to take measurements accurately.

379. HITCHCOCK, E. Physical Measurements; Fallacies and Errors. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1887, (3), 35-42.

Hitchcock reaches the conclusion in this discussion that "human measures increase with height, always understanding that the law will not include some of the tests of strength." A criticism of the Hemenway charts is also included.

380. HITCHCOCK, E. (a). *Anthropometrical Data Based upon Nearly 3000 Measurements Taken from Students.* Amherst: 1888.

Included in program of exhibition of physical exercises (a, b, c, d, e).

381. HITCHCOCK, E. (b). *Average and Mean Anthropometric Data of Amherst College Students.* Amherst: 1888.
A series of elaborate tables.

382. HITCHCOCK, E. (c). *The Gain in Physical Strength of College Students.* Amherst: 1892.
Two tables.

383. HITCHCOCK, E. (d). *Physical Growth of Amherst Students.* Gain between Freshman and Senior Years. Amherst: 1892.

384. HITCHCOCK, E. (e). *The Distribution of Physical Measurements Shown in the Different Years of College Life.* Amherst: 1892.

385. HITCHCOCK, E. A Synoptic Exhibit of 15,000 Physical Examinations. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1890, (5).

386. HITCHCOCK, E. Comparative Study of Measurements of Male and Female Students at Amherst, Mt. Holyoke & Wellesley Colleges. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1891, (6), 37-42.
A discussion of Bowditch's paper on percentile grades, accompanied by three tables. The first table gives the average measurements of 2000 students; the second, the means rather than the averages for 2086 students; and the third, the average measurements of 326 college men between 21 and 22 years of age.

387. HITCHCOCK, E. *The Results of Anthropometry as Derived from the Measurements of the Students in Amherst College.* Amherst, Mass.: Carpenter & Morehouse, 1892. Pp. 7.
This consists principally of six tables (50 items) of measurements for students 16 to 26 years of age.

388. HITCHCOCK, E. Anthropometric Statistics of the Students of Amherst College. *Amer. Statis. Ass'n.* (quarterly), 1893, (3), 588-599.
A summary of the statistical work of the department of physical education.

389. HITCHCOCK, E. AND ANDERSON, W. G. Report of the Committee on Statistics Appointed by the Association in 1885. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1888.
A comprehensive summary of what measurements should be taken and how it should be done, including detailed methods, tests, and a discussion of the conditions of the body.

390. HITCHCOCK, E., SEELEY, H. H. AND PHILLIPS, P. C. *The Anthropometrical Manual of Amherst College.* Amherst, Mass.: Carpenter & Morehouse, 1900. Pp. 40.
This is one of the early manuals with directions for making measurements and tables of norms for 53 measurements, arranged to show the average, etc.

391. HOFFMAN, F. L. *Army Anthropometry and Medical Rejection Statistics.* Newark, N. J.: The Prudential Press, 1918. Pp. 114.
A preliminary study of "rejection data."

*392. HOFFMANN,— Diss. Rostock: 1918.
Data are given to show that war babies are not physically inferior to those born previous to war times as Kettner claimed in 1916.

*393. HOFMANN,— Über die Gewichtszu- und Abnahme neugeborner Kinder. *Neue Zsch. f. Geburtsk.*, 1849, (27), 146-148.
The weights of 36 children were taken daily for five days and for some of the children the weighing extended to the 18th day.

394. HOLMES, B. A Study of the Growth of Children, being a Review of the Work of Dr. Wm. T. Porter of St. Louis. *N. Y. Med. J.* 1894, (60), 417-423.
A critical discussion of Porter's work.

395. HOLMGREN,— Einfluss der Basedowsche Krankheit auf das Längenwachstum. *Nord. med. Archiv*, 1909 og 1910.

*396. HOLT, L. E. *The Diseases of Infancy and Childhood.* New York: D. Appleton, 1916. Pp. 1180.

Contains a chapter on Growth and Development with weight charts, and tables of measurements taken from other authorities. No data are given for the author's own weight chart in this edition. The 1920 edition by Holt and Howland contains norms at six month intervals from birth to four years.

397. HOLT, L. E. Standards for Growth and Nutrition. *Amer. J. Dis. Child.* 1918, (16), 359-375. Also *Trans. Amer. Pediat. Soc.*, 1918, (30), 73-92.

A good review of the principal investigations in this field with graphs showing the scattered distribution of records for any age, height or weight, which makes the fixing of standards of growth very difficult. Some new data on 350 boys from the Browning School of New York City are given in a graph.

398. v. HÖSSLIN, H. Über die Ursache der scheinbaren Abhängigkeit des Umsatzes von der Grösse der Körperoberfläche. *Arch. f. Anat. u. Physiol.*, (Physiol. Abteilg.), 1888.

399. HOWARD, F. G. War Bread and Growth of Children. *Medical Officer*, Jan. 11, 1919.

*400. HOWLAND,— AND DANA,— A Formula for the Determination of the Surface Area of Infants. *Amer. J. Dis. Child.*, 1913, (6), 33.

401. HRDLIČKA, A. Physical Differences Between White and Colored Children. *Amer. Anthropol.*, 1898, (11), 347-350.

Colored children are found to be less variable, taller, lighter in weight and smaller in head circumference.

402. HRDLIČKA, A. *Report on Anthropological Work in the State Institution for Feeble-Minded Children.* New York: Wynkoop, Hallenbeck, Crawford Co., 1899. Pp. 98. See also *J. Psycho-Asthen.*, 1898-99, (3), 47-75.

403. HRDLIČKA, A. Anthropological Investigations on 1000 White and Colored Children of Both Sexes. *47th Ann. Rep., New York Juvenile Asylum.* New York: Hallenbeck Crawford Co., (state printers), 1899, (47), 1-86.

The author finds these children in general somewhat inferior to healthy children from good homes but attributes it in most cases to neglect and improper nutrition. The report contains the results of much painstaking anthropometrical research and a discussion on the unreliability of the "stigmata of degeneration."

404. HRDLIČKA, A. *Physiological and Medical Observations among the Indians of the South West United States and New Mexico.* Washington: Gov. Print. Off., 1908. Pp. 460.

Contains extensive studies of the Indian child.

405. HRDLIČKA, A. Physical Anthropology, its Scope and Aim, its History and Present Status in America. *Amer. J. Phys. Anthropol.*, 1918, (1), 133-182; 267-304; 377-414. Rev. Ed., Philadelphia: Wistar Institute, 1919.

This is a complete historical review with references to the works of American investigators on physical anthropology.

406. HRDLIČKA, A. Anthropometry of the Living. *Amer. J. Phys. Anthropol.*, 1919-20.

Directions for making measurements according to modern technique.

407. HULTKRANTZ, J. V. Über die Körperlänge der Schwedischen Wehrpflichtigen. *Centralbl. f. Anthropol.*, 1896, (1), 289-291.

408. HURD, K. C. Some of the Francis Galton Tests Concerning the Origin of the Human Faculty. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1891, (6), 80-96.

An application of Galton's measurements to Bryn Mawr schools and Bryn Mawr College, including some anthropometric measurements.

409. HUTCHINSON, J. On the Capacity of the Lungs and on the Respiratory Functions, etc. *Med. Chir. Trans.*, 1846, (29), 137-252.

A good pioneer study in lung capacity.

410. ICHAK, F. AND FRIEDENTHAL, H. Über graphische Darstellung von Wachstumserscheinungen. *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, (2), 281-286.

*411. INGERSLEV,— (Birth Measurements of Infants) *Nord. med. Arch.*, 1875, (7), No. 7. Also *Obstet. J. of Gr. Brit. and Irel.*, 1876, (3), 705.

Measurements of 3450 infants gave an average weight of 3333.5 grams. An increase of weight was noted from the 1st to the 5th pregnancy. Of interest chiefly because it reports an early experiment to determine causes of loss.

412. IRELAND, M. W., LOVE, A. G. AND DAVENPORT, C. B. *Physical Examination of the First Million Draft Recruits.* (War Dep. Off. of the Surg. Gen., Bull. No. 11). Washington: Gov. Print. Off., 1919. Pp. 521.

The results of the physical examination of men sent to mobilization camps are exhaustively analyzed in many tables and graphs to show the incidence of defect in various states, in rural and urban districts, etc.

*413. ISSMER,— (Birth Measurements of Infants). *Arch. f. Gynäk.*, 1899, (30), 277.

Issmer measured 7612 infants in Dresden and Munich and found their average weight to be 3267 grams and their average height 50.3 cm. He found that these measurements increased with the age of the mother and the number of the pregnancy.

*414. JACKSON, C. M. Growth of the Embryo. *Amer. J. of Anat.*, 1909, (9), 119-165.

A good presentation of the facts of growth discovered as a result of measurement of specimens.

415. JACKSON, W. A., Jr. Tables of the Anthropometric Measurements of the Williston Seminary Students. *The Willistonian,* Easthampton, Mass., 1892. Pp. 140.

416. JACKSON, W. A., Jr. Graphic Methods in Anthropometry. *Phys. Educ.*, 1893, (2), 89-94.

Diagrammatic charts on physical growth and proportions of different parts of the body.

*417. JASCHKE,— Neue Beiträge zur Physiologie und Technik der natürlichen Ernährung der Neugeborenen. *Zsch. f. Geburtsh. u. Gynäk.*, 1913, (74), 494-541.

This article is mostly concerned with nutrition, but includes a number of curves showing the effect of diet on weight.

418. JEANNERET, L. AND MESSERLI, F. Un nouveau mode de contrôle de la croissance de l'enfant. *Rev. Méd. de la Suisse Rom.*, 1917, (37), 570-573.

Discusses the "photo-anthropometrique" method of registering the growth of a child.

*419. JUDSON, C. F. AND GITTINGS, J. C. *The Artificial Feeding of Infants.* Philadelphia: Lippincott, 1902. Pp. 368.

This is a general treatise with a chapter on the Weight and

Growth of the infant, containing tables and graphs from the principal investigators.

420. KAISER, H. Das Wachstumsgesetz. PFLÜGER'S *Arch. f. d. ges. Physiol.*, 1875, (11), 610-624.
This consists purely of the mathematical derivation of a growth formula without observational material.

421. KARNIKKI, A. O. (Law of Periodicity in the Increase of Weight in Children.) *Vrach. Gaz.*, 1903, (13), 47-50.
Russian.

*422. KARNITZKY, A. C. Zur Physiologie des Wachstums und der Entwicklung des kindlichen Organismus. *Jahrb. f. Kinderheilk.*, 1908, (68), 462-474.
This is a plea for individual study including blood tests as well as the usual measurements of physical growth. Preliminary results are given for one child, showing that the normal healthy child loses weight during the first days of life, regains the birth weight at 10 days, and gains steadily thereafter (if breast fed) contrary to the opinion of other investigators who find sporadic periods of no increase.

*423. KASTNER, O. Körpervolumen und specifisches Gewicht von Säuglingen. *Zsch. f. Kinderheilk.*, 1911-12, (3), 391-412.
Contains measurements on 154 living infants and good references.

424. KAY, T. Tables Showing Height, Weight, Mental Capacity, Condition of Nutrition, Teeth, etc. (of Glasgow School Children). *J. Roy. San. Inst.*, 1904-05, (26), 907-913.

425. KELLOGG, J. H. *Outline Studies of the Human Figure*, (comprising 118 figures which embody the results of several thousand observations, embracing studies of a number of different civilized and uncivilized races.) Chicago, Battle Creek, Mich.: Mod. Med. Pub. Co., 1893.

426. KELLOGG, J. H. The Value of Strength Tests in the Prescription of Exercise, and a Comparative Study of the Strength of Individual Groups of Muscles, and of Homologous Muscles of Men and Women. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1896, 49-75.
Many physical measurements of different parts of the body are included.

427. KERR, J. Standard Measures of School Children. *School Hygiene*, 1918, (9), 4-15.
Discusses seasonal variations and the value of physical training. Measures of height and weight for ages six to 17 are reported somewhat dogmatically as final standards.

428. KERR, J. Standard Measurements for School Children. *Mind and Body*, 1919, (26), No. 281, 193-212. Reprinted from *Amer. J. of Sch. Hyg.*
A review of recent work with a few tables and graphs. The writer mentions a number of investigations not usually referred to in the literature.

429. KETTNER, A. H. Das erste Kriegsjahr und die grossstädtische Volksschulkinder. *Dtsch. med. Woch.*, 1915, (41), 1428-1430.
This contains four charts showing the percentile distribution of increments for height of nine year old boys, weight of 11 year old boys, weight of 10 year old girls, and height of 12 year old girls in 1913-14 and 1914-15. The war curves are all shifted toward the end of the scale representing smaller amounts of increment, that is, fewer children show large increments and many more smaller increments.

430. KEY, A. *Läroverkskomiténs betänkande III Bilage E.* Stockholm: Kongl. boktryckeriet, 1885.
Edited in German by Bürgerstein. *Schulhygienische Untersuchungen,* Hamburg, 1889.
A report of the Swedish commission of which Key was appointed chairman in 1882. About 15,000 boys and 3000 girls were examined. Most of the book is concerned with hygienic investigations and an important contribution is made bearing on the relation of disease to nodes of growth. The study of the height and weight extends from the age of six to 20 years.

431. KEY, A. *Schulhygienische Untersuchungen.* Leipzig und Hamburg: Bürgerstein, 1889. Pp. 346.
Key found in Sweden that liability to sickness decreases with increasing rate of growth, and increases with decreasing rate of growth; therefore, one may be taken as the measure of the other.

432. KEY, A. *Die Pubertätsentwicklung und das Verhältnis derselben zu den Krankheitserscheinungen der Schuljugend.* Reprinted from *Proc. of the 10th Internat. Cong. of Med.,* 1890, (1), 66-130.

433. KEY, A. Pubertetsutvecklingen och Sjukligheten hos Skoleungdomen. *Nord. med. Archiv.,* 1891.

*434. KÉZMARSKY, T. Über die Gewichtsveränderungen reifer Neugeborener. *Arch. f. Gynäk.,* 1873, (5), 547-561.
The weights of 73 children are reported and the usual conclusions drawn in regard to the factors entering into the physiological loss of weight.

*435. KÉZMARSKY, T. (Birth Measurements of Infants) *Mittheil, a. d. geburtsh. u. gynäk. Klin. in Budapest über d. Jahre 1874-82.* 1884.

436. KIMPFLIN, G. Les lois de la croissance physique pendant l'enfance et l'adolescence. *Compt. rend. de acad. d. sci. de Paris,* 1914, (158), 801-803.
Measurements are reported for the height and weight of 200 children 11 to 16 years. The writer observed that from 11 to 14, growth in height was particularly active and from 14 to 16 growth in weight. Values reported here are higher than the averages of Quetelet, Variot and Chaumet, Godin, and other French investigators.

*437. KING, I. Measurements of the Physical Development of Two Children. *J. of Educ. Psychol.,* 1910, (1), 279-286.
An important individual study of the author's two boys, one between the ages of birth and six years, and the other for the first three years. 14 measurements besides height and weight are included.

438. KIRCHHOFF, A. Zur Statistik der Körpergrösse in dem Saalkreise zu Halle und dem Mansfelder Seekreise. *Arch. f. Anthropol.,* 1892-93, (21), 133-143.
In this investigation, which was carried on in 1882, Kirchhoff makes some very interesting comparisons. 2637 measurements were made in the Saalkreis and 2812 in the Seekreis.

439. KIRKOFF, N. Recherches anthropologiques sur la croissance des élèves de l'École militaire de S. A. R. de Prince de Bulgarie, à Sofia. *Bull. et mém. de soc. d'anthrop. de Paris,* 1906, 5 s. (7), 226-233.

440. KIRKPATRICK, E. A. Physical Growth and Development. In *Fundamentals of Child Study.* New York: Macmillan Co., 1917, 32-46.

A brief but suggestive discussion on the general problem of growth.

*441. KIRSTEIN, F. Über die physiologische Gewichtsabnahme Neugeborener. *München med. Woch.*, 1917, (64), 1178.

*442. KIRSTEIN, F. Über die physiologische Gewichtsabnahme Neugeborener. *Zsch. f. Geburtsh. u. Gynäk.*, 1917-18, (80), 448-465.

*443. KJÖLSETH, M. Untersuchung über die Reifezeichen des neugeborenen Kindes. *Monatsch. f. Geburtsh. u. Gynäk.*, 1913, (38), 216-298.

A careful study of five measurements and other characteristics of infants born seven to nine months after conception. Reference list of 96 numbers.

444. KNOOP, L. Zum Index aus Körperhöhe und Armspannung. *Kor. Bl. d. dtsch. Gesellsch. f. Anthropol.*, 1918, (49), 26.

445. KOCH-HESSE, A. Ein Beitrag zur Wachstumsphysiologie des Menschen. *Zsch. f. Schulgesundheitspf.*, 1905, (18).

This study is of special importance for its table of height and weight of children (about 12 years of age), arranged according to nationality and economic condition of the parents. This table is a compilation of the results of 26 different investigations in various parts of the world. A similar table is given for children of about 14 years of age.

*446. KÖRBER,— (Birth Measurements of Infants). *Vierteljahrsch. f. gerichtl. Med.*, 1884, n. F. (40), 225.

Reports the length of 2495 St. Petersburg foundlings and 5528 Moscow foundlings.

447. KOREN, A. Die Körperlänge norwegischer Soldaten. *Kor. Bl. d. dtsch. Gesellsch. f. Anthropol.*, 1901, (32), 46.

448. KOSMOWSKI, W. Über Gewicht und Wuchs der Kinder der Armen in Warschau. *Jahrb. f. Kinderheilk.*, 1894, (39), 70-76.

This is a study of the measurements of 1540 boys and 1898 girls 8-15 years of age (not successive measurements). These children were measured in Ferien-Kolonien and in the author's general practice. Many comparative tables are included.

449. KOTELMANN, K. Der Körperverhältnisse der Gelehrtenschüler des Johanneums in Hamburg. *Zsch. d. kgl. preusz. statist. Bur.*, 1879, (19), 1-16.

This article shows the effect of school conditions, especially in the secondary school, where physical training was given, to be very beneficial. Height, weight and lung capacity of 115 boys from 10 to 15 years are reported.

450. KÖTZ, A. Wachstumssteigerung einer Körperhälfte im Kindesalter. *Monatschr. f. Kinderheilk.*, 1918-19, (15), Orig., 389-396.

*451. KRÜGER, G. Über die zur Nahrung Neugeborener erforderlichen Milchmengen mit Rücksicht auf die Gewichtsveränderungen der Kinder. *Arch. f. Gynäk.*, 1875, (7), 59-106.

Fairly complete records on 12 cases followed for about 12 days, showing fluctuations in weight, together with other data.

452. KUBO, T. Rassenanatomische Untersuchungen an Chinesen. *Mitt. a. d. Med. Fakult. d. k. Univ. zu Tokyo*, 1912, (14), 37-57; 1915, (17), 345, 373, 401.

453. KUBO, T. Physical Anthropological Study of the Korean People. *China Med. J.*, 1917, (31), 523-550.

454. KUBO, J. Korean Stature and Weight Compared According to Provinces. *Chosen Igakukai Zasshi.* No. 19, Transl. and abstr., *China Med. J.*, 1918, (32), 566.

455. KULKA, W. Studien zur Wachstumsphysiologie an den Zöglingen einer militärischen Erziehungsanstalt. *Österr. San-Wes.*, 1912, (24) 1365-1383.
Tables are given for growth in height, weight and chest circumference.

456. LANDSBERGER,— Das Wachstum der Knaben vom 6 bis zum 13 Lebensjahre. *Zsch. f. Schulgesundheitspf.*, 1888, (1), 65-69.
An important investigation based on consecutive measurements of 37 children between the ages of six and 13. Many other measurements are included and a comparison is made with the work of Bowditch and other investigators.

457. LANDSBERGER,— Das Wachstum im Alter der Schulpflicht. *Arch. f. Anthropol.*, 1888, (17), 229-265.
This is an important detailed study of boys six to 13 years of age, including six yearly determinations of 22 measurements on 37 to 104 individuals (nude). The data are arranged for comparison between rich and poor, German and Polish. Comparisons are made with the material of other investigators.

458. LANE, W. A. Some of the Laws which Influence the Growth of Children. *Proc. Internat. Cong. Hyg.*, London: 1892, 103-109.
A general discussion.

459. v. LANGE, E. *Die normale Korpergrösse des Menschen von der Geburt bis zum 25 Lebensjahre.* München: Lehmann, 1896.
This is a résumé, without specific references, of previous work. Comparative tables are included but the curves constructed from there are too much smoothed to be really useful.

460. v. LANGE, E. Die Gesetzmässigkeit im Längenwachstum des Menschen. *Jahrb. f. Kinderheilk.*, 1903, (57), 261-324.
This study is based on the writer's work from 1890 onward, with some new data. His aim is to discover the laws of growth. With this end in view, he has subjected to mathematical treatment a large amount of material of his own and of other investigators and constructed ideal curves from birth to 20 years of age. All these curves are smoothed in such a way as to give the impression that growth goes on in a perfectly uniform fashion.

*461. LANGE-NIELSEN, C. (The Weight and Length of New-born Infants in Norway). *Norsk. Mag. f. Laegevidensk.* Kristiania: 1918, (79), 1134-1145.
Birth weight and length of about 1100 Norwegian infants are studied. Both measurements are found to increase with the age of the mother and with the serial order of the pregnancy. Norwegian infants are found to be heavier and longer than German or Danish infants.

*462. LANGSTEIN, L. Hunger und Unterernährung im Säuglingsalter. *Jahreskurse f. ärztl. Fortb.*, 1912.

*463. LANGSTEIN, L. AND MEYER, L. F. *Säuglingsernahrung und Säuglingsstoffwechsel.* Wiesbaden: Bergmann, 1914. Pp. 408.
This is a general text on nutrition with a section *Die physiologische Entwicklung des Säuglings.*

*464. LASCOUX, P. *Etude sur l'accroissement du poids et de la taille des nourrisons.* Diss. Paris: Michalon, 1908.

465. LASSABLIÉRE,— Évaluation de la surface cutanée chez le jeune enfant. *Compt. rend. soc. de biol.*, 1910, 339.

466. LAUMONIER, J. Les proportions normales du corps chez les enfants. *Corresp. méd.*, 1909, (16), No. 351, 16.

467. LAURENT, A. Les lois de la croissance et l'éducation physique. *Méd. inf.*, 1894, (1), 619; 667.

468. LEE, A. AND P. K. Data for the Problem of Evolution of Man. *Philos. Trans. Roy. Soc.*, 1901, (196), 225-264. Ser. A.
A good treatment of the general problem of physical development.

469. LEE, A., LEWENZ, M. A., AND PEARSON, K. On the Correlation of the Mental and Physical Characters in Man. *Proc. Roy. Soc.*, 1903-04, (71-72), 106-114.
Further analysis of the Cambridge University material, leading to the conclusion that the correlations of intelligence with the ratios of length and breadth of head to stature are slightly smaller than the correlations of intelligence with the absolute head-measurements. Correlations are also given for intelligence with strength of pull, sight, weight, weight per inch of stature, and athletic ability.

470. LENTZ, E. Physiologische Schwankungen im Jugendalter und ihr Einfluss auf die geistige Arbeit. *Zsch. f. päd. Psychol.*, 1917, Part 1 and 2, 23-40.
Previous work in this field up to 1917 is outlined. Taking school attendance as an index of general health (after Lobsien), the records of 300 Gymnasium children and 950 elementary school children were analyzed. It appeared that the months of April-May, and of September-October, were best for general health, while November and December were worst. Psycho-pedagogical recommendations were made with reference to examinations, school marks, vacations, etc.

471. LESHAFT,— (Materials for the Study of the Years of School Life.) *Health*, 1879-80, 127-131.
Russian, cited by Sack.

*472. LETOURNEUR,— *De l'influence de la profession de la mére sur le poids de l'enfant.* Diss. Paris: 1897.

473. LÉVY, E., MAGNAN,— AND SELLET,— Relation entre la croissance de la taille et le développment du périmètre thoracique chez l'homme. *Rev. prat. d'obst. et de paediat.*, 1914, (27), 13-21.

474. LIHARZIK, F. *Das Gesetz des menschlichen Wachstums.* Wien: Gerolds Sohn, 1858. Pp. 188.
A good pioneer study of measurements of the head and chest.

475. LIHARZIK, F. Der Bau und das Wachstum der Menschen. *Sitzungsber. d. königl. Akad. in Wien.* (Mathemat.- naturwissensch. Klasse), 1861, (44), Part 2.

476. LIHARZIK,— *Das Gesetz des Wachstums und der Bau des Menschen.* Vienna: 1862.

477. LINCOLN, D. F. Anthropometry Individualized. *Amer. Ass'n, for the Adv. of Phys. Educ.*, 1896, 4-11.
A practical paper with some very good observations on sexual maturity.

478. LIPIEC, M. Über das Wachstum der polnischen Jüdinnen. *Mitt. d. anthropol. Gesellsch. in Wien,* 1912, (42), 115-195; 281-334.
Measurements are reported for 340 girls 10 to 19 years of age. Thirteen measurements are recorded in full and studied absolutely and in comparison with the work of other investigators. The writer concludes that growth between these years comprises 20% of the total growth, that growth from 10 to 15 is fast, and from 15 to 19 slow, and that in the latter years growth in breadth is faster than in length. No pronounced corresponding change in indices was noted.

479. LIPIEC, M. Veränderungen in den kopfdimensionen bei Warschauer Jüdinnen. *Bull. intern. acad. d. sci. de Cracovie,* 1912, B., 633-648.

*480. LISSAUER,— Über Oberflächenmessungen an Säuglingen. *Jahrb. f. Kinderheilk.*, 1903, (58), 392-411.

A good discussion of the development of formulae, together with references.

481. LIVI, R. Saggio di antropometria militare. *Atti di Soc. rom. di antropol.*, 1894, (1), 292-307.

482. LIVI, R. L'indice pondéral ou rapport entre la taille et le poids. *Archive ital. de Biol.*, 1899, (32), No. 2.

483. LOMMEL, F. Über den Einfluss des Kriegs auf den Ernährungszustand der Bevölkerung in Jena. *Berl. klin. Woch.*, 1916, (53), 293.

484. LOMMEL, F. Über den Einfluss der Kriegsmässig veränderten Ernährung. *Dtsch. med. Woch.*, 1916, (42), 351-353.

The weight of a large number of infants of the less favored classes was copied from the records of the Polyclinic. War conditions were found to have no influence on the growth of these infants. In fact the curves of the breast-fed and the artificially-fed were found to coincide with the normal curves of Camerer. For the years 13½ to 18½ the investigator used about 2000 weight determinations on over 50 employees of a firm in Jena. Practically the same individuals had been measured semi-annually for a number of years previous to the war. Comparison of the weights for each age group before and after 1915 and of the increments from one weighing to the next showed only a very slight difference in favor of the years before 1915. The investigator considers this difference quite unimportant.

485. v. d. LOO, C. J. Over lengte en gewicht van Kinderen in den leeftijd van 6-12 jaar. *Nederl. Tijdschr. v. Geneesk*, 1919, (20), 976-986.

*486. LOREY,— (On the Growth of Infants) *Jahrb. f. Kinderheilk.*, 1888, n. F., (27), 339.

For this article on physical growth the same material was used as that upon which Schmid-Monnard's work was based. (*Jahrb. f. Kinderheilk.*, 1892, (33), 327-350).

487. LÜBSEN, J. (State of Nourishment of Amsterdam School Children During the War). *Nederl. Tijdschr. v. Geneesk.*, 1917, (2), No. 21, 1865. Also *Nederl. Zsch. f. Heilk.*, Novbr. 24, 1917. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 579.

Height and weight of 3680 school children was recorded in January 1916. In January 1917, 5064 children were measured. No evil effect from war conditions was apparent. Lübsen cites similar investigations during the past two years in Germany.

488. LUCAE, J. Ein Beitrag zum Wachsen des Kinderkopfes vom 3 bis 14 Lebensjahre. *Festsch. zur 13 Jahresversamml. d. dtsch. anthropol. Gesellsch.* Frankfurt a. M.: 1882.

*489. LUTZ, R. Die körperliche Entwicklung des Neugeborenen. *Centralbl. f. Gynäk.*, 1912, (36), 1577-1581.

Height and weight of infants born after 28-44 weeks' pregnancy.

490. MACDONALD, A. Experimental Study of Children. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1897-98, (1), 989-1204; (2), 1281-1390.

An extensive study of numerous physical and mental measurements of white and colored children in Washington. A number of comparisons of head measurements are made, and it is concluded that white girls have a greater standing height and sitting height than colored girls, but colored children have a greater weight than white children. Children of the laboring class are

superior in height, sitting height, and weight to those of the non-laboring class, which confirms the results of Roberts, Bowditch, and Baxter. Girls are superior to boys in their studies. Children with abnormalities are inferior in height, weight, and the other measurements included.

Many charts, tables and illustrations are given, and a list of references is appended.

491. MACDONALD, A. Man and Abnormal Man. 58th Congress, 3d Session, 1904-05, *U. S. Senate Documents* (9), No. 187. Pp. 780.

This is a reprint of six of the author's government publications including his *Experimental Study of School Children, Child Study in the United States, Statistics of Crime, Suicide and Insanity, and Insanity and Genius*, with many references.

492. MACDONALD, A. Beiträge zu der Entwicklung und der Entwicklungsfehlern der Kinder. *Jahrb. f. Kinderheilk.*, 1910, (71), 180-188.

In this article the author further examines statistics previously published under the title *Man and Abnormal Man*, and presents additional information in regard to head size and intelligence; cephalic index in puberty; abnormalities and defects in relation to sex, intelligence, nationality and social class; intellectual ability in relation to sex, nationality and social class; etc.

493. MACDONALD, A. Anthropometry of Civilized Man. *Med. Fortnightly*, 1919, (51), 61-65.

This consists mostly of conclusions drawn from the author's data published in *Man and Abnormal Man.*

494. MACKEPRANG,— De Vernepligtiges höide i Danmark. *Medd. Danm. Anthrop.*, 1907-11, (1, 2).

A study of the physique of men subject to military duty.

495. MACLAREN, A. *Physical Education.* Oxford: Clarendon Press, 1895. Pp. 462.

A plea for physical education with directions for exercising on pieces of apparatus that are illustrated. A table on page 438 shows the average height, weight, girth of chest, forearm and upper arm obtained from 100 boys at each age from 10 to 18 years.

496. MAKOWER, A. A. Untersuchungen über Wachstum. *Zsch. f. Schulgesundheitpfl.*, 1914, (27), 97-120.

Measurements are given for 400 Jewish children in Wilna, showing that there are no specific racial differences in growth, but a general increase in growth during vacation time, with a loss of weight during examination time. There is an apparent contradiction between these results and those of Schmid-Monnard (though he is not mentioned by Makower). Makower's weight increase during vacation seems to coincide with Schmid-Monnard's weight increase in August and September, during which the Russian summer vacation occurs. Both investigators are possibly proving the same general law.

497. MALLING-HANSEN, P. R. *Über Periodizität im Gewicht der Kinder.* Kopenhagen: 1883. Pp. 35.

Deals primarily with the seasonal and daily variations in growth due to climatic conditions.

498. MALLING-HANSEN, P. R. Einige Resultate der täglichen Wägungen von 130 Zöglingen des königlichen Taubstummeninstituts in Kopenhagen. *Congr. period. internat. d. sci. med.* Kopenhagen, (3), 103-119.

This is an address covering the subject of seasonal variations,

and a consideration of the effect of change of diet on growth in weight at different times of the year.

499. MALLING-HANSEN, R. *Perioden im Gewicht der Kinder und in der Sonnenwarme.* Kopenhagen: Tryde, 1886. Pp. 268.
This contains measurements of 130 boys and girls in an institution for the deaf and dumb. The author finds that variations in the weight of children are coincident with variations in the heat of the sun's rays, and draws rather fantastic conclusions from this coincidence.

500. MANOUVRIER, L. Étude sur les rapports anthropométriques en général et sur les principales proportions du corps. *Bull. et mém. soc. d'anthropol. de Paris,* 1902, 3 s., (2), 3-202.

*501. MARFAN, A. B. *Traité de l'Allaitement.* Paris: 1899 (1st ed.). Pp. 586.
Weight is mentioned briefly in connection with other physical signs of good feeding.

502. MARTIEGKA, H. Über die Beziehung zwischen Körperbeschaffenheit und geistiger Thätigkeit bei Schulkindern. *Mitt. d. anthropol. Gesellsch. in Wien,* 1898, n. F., (18), 122-126.

*503. MARTIN, C. (Birth Measurements of Infants.) *Monatschr. f. Geburtsk. u. Frauenkrankh.,* 1867, (30), 428.
Reports weight of Berlin infants.

504. MARTIN, E. L'anthropométrie appliquée à l'étude du développement des enfants anormaux. *L'enfance anorm.,* 1912, 417-425.

505. MARTIN, R. *Lehrbuch der Anthropologie.* Jena: 1914. Pp. 181.
Contains a discussion of racial differences in bodily proportions among much other important material.

506. MARTY, J. Recherches statistiques sur le développement physique des délinquants. *Arch. d. l'anthropol. crim.,* 1898, (8), 178-195.

507. MATTHIAS, E. *Der Einfluss der Leibesübungen auf das Körperwachstum.* Zürich: Rascher & Co., 1916. Abstract in *Zsch. f. Schulgesundheitspf.,* 1916, (29), 375-376.
Matthias investigated the effect of physical exercise on 737 Swiss athletes, 16-22 years of age, by means of the individualizing method. Each subject was measured three times a year. The conclusion was drawn that exercise greatly stimulates growth.

508. MATUSIEWICZ,— *Der Korperlängen-Körpergewichts-Index von Münchner Schulkindern.* Diss. München: Müller & Steinicke, 1914.

509. MATVEYEVA, V. G. (Physical Development of the Children of the St. Petersburg Public Schools). *Vrach.* 1895, (21), 918; 941.
Russian.

510. MAUREL, M. E. Adaptation de la section thoracique à la surface cutanée par rapport au poids depuis la naissance jusqu' à l'âge adulte. *Compt. rend. soc. biol.,* 1904, 980-981.

511. MAYET, L. La valeur moyenne du coefficient de robusticité chez les enfants de sept à treize ans d'apres 1250 observations et 5000 mensurations. *35 Congrès de l' A. F. A. S. C. R.,* 1906.

*512. MAYET, L. Le développement physique de l'enfant. *J. méd. franc.,* 1912, (6), 366-374.
This article is concerned with individual variations in weight and with the discussion of the "coefficient du robusticité."

513. MEAD, C. D. Height and Weight of Children in Relation to General Intelligence. *Ped. Sem.,* 1914, (2), 394-406.
Herein are reported measurements of 288 boys and 141 girls

of an Indiana institution. Five tables and five graphs are given which show that the degree of mental defect is closely correlated with the degree of physical defect.

514. MEEH, K. Oberflächenmessungen des menschlichen Körpers. *Zsch. f. Biol.*, 1879, (15), 425-458.
This contains formulae, comparative tables from other investigators, and drawings showing the regions of the body to be measured.

515. MEEH, K. Volummessungen des menschlichen Körpers und seiner einzelnen Theile in den verschiedenen Alterstufen. *Zsch. f. Biol.*, 1895, (31), 125-147.
This contains measurements of four cadavers and 10 living individuals, together with a review of previous work, tables of measurements, diagrams of the divisions of the body and charts to show the relationship of the volume of a single part of the body to the total volume in infant and adult life.

516. MEGRET, A. *Anthropométrie normale.* Paris: Laurens, 1895. Pp. 75.

517. MENARD, S. *Contribution à l'étude de la croissance chez l'homme et chez les animaux.* Paris: 1885.

518. MERESHOFFSKY, K. (On the Results and Methods of the Investigation of the Physical Development of Children.)
Russian, cited by Sack.

519. MERRINS, E. M. Anthropometry of Chinese Students. *China Med. J.*, 1910, (24), 318-324.
This contains measurements of the height and weight of 219 boys and 69 girls in the Wuchang schools for the ages 11 to 22. Chinese children are found to be lighter and shorter than certain American and English norms.

520. MERZ,— Recherches statistiques relatives à la valeur des indices numériques d'aptitude physique au service militaire. *J. de méd. et de chir. pratiq.*, 1901, (19), 211.

521. MEUMANN, E. *Vorlesungen zur Einführung in die Experimentelle Pädagogik.* Leipzig: Engelmann, 1911. Pp. 725.
The third part of this book contains a valuable chapter on growth. References are appended.

*522. MEYER, L. F. Über den Wasserbedarf des Säuglings. *Zsch. f. Kinderheilk.*, Orig., 1912, (5), 1-30.
This deals primarily with nutrition. There are a few graphs showing the effect of diet on weight.

523. MICHAILOFF,— (Materials for the Estimation of Physical Development and Disease in the Village School of Russik in the Province of Moscow.) *Fisitscheskoje raswitje utschastschichsja w selskich schkolach Rosny.* Moskau: 1887.
Found that children who are attending school are better developed than peasant children who are not going to school.

*524. MIES, J. (Birth Measurements of Infants) *Virchow's Archiv. f. d. path. Anat. u. Physiol.*, 1891, (123), 191.
Reports the length of 795 boys and 810 girls in a hospital in Köln.

525. MIES, J. Über die Masse, den Rauminhalt und die Dichte des Menschen. *Virchow's Arch. f. d. path. Anat. u. Physiol.*, 1899, (157), 90.

526. MILAÏLOW,— *(Report of the Municipal Council of Moskow)*, 1890.
Russian, cited by Wiazemsky.

*527. MILLER,— (Birth Measurements of Infants). *Jahrb. f. Kinderheilk. u. phys. Erziehung*, 1893, (36), 338.

Reports the birth measurements of foundlings in Moscow, including measurements of twins.

528. MISAWA, T. A Few Statistical Facts from Japan. *Ped. Sem.*, 1909, (16), 104-112.

In 1901 the Department of Education of Japan measured the heights and weights for 869,014 children. Misawa reports the results of this study in the above article.

529. MIWA, N. *A Study Upon Weight from 3 to 80 Years of Age.* Tokio: I-Gauk-Zwai-Zatumshi, 1893, (7), No. 9.

These measurements begin in the kindergarten and extend through the schools and to adults from other sources. A study of the effect of the weights in different classes of society is included, together with the problem of maturity. Also MIWA,— AND STOELTZNER,— Bemerkungen über die Bestimmung der Körperoberfläche des Menschen. *Zsch. f. Biol.*, 1898, (30), 314.

*530. MONTAGUE, H. AND HOLLINGWORTH, L. The Comparative Variability of the Sexes at Birth. *Amer. J. of Sociol.*, 1914, (20), 335-370.

Study of a series of physical measurements on two thousand infants measured in the New York Infirmary for Women and Children, the aim of the study being to determine, "Are males inherently more variable in anatomical traits than females?" The results show no inherent differences in anatomical variability.

531. MONTESSORI, M. *Pedagogical Anthropology.* New York: Stokes, 1913. Pp. 500.

A general exposition of the history and facts of anthropometry. As it is composed of lectures at the University of Rome, specific references are omitted.

532. MONTI, A. Das Wachstum des Kindes von der Geburt bis einschliesslich der Pubertät. *Wien. Klinik*, 1898, (24), 287-316. Also *Kinderheilk. in Einzeldarstell.*, Wien: 1898, Heft 6.

This consists of a lecture without specific references, but covering in considerable detail the contributions of various early investigators, and giving their tables, together with tables averaged from various sources. Weight, height, circumference of head and chest, body volume and surface, are included in the general discussion.

533. MOON, S. B. Measurements of the Boys of the McDonogh School for 1881-91. *McDonogh School*, Md.: 1892. Pp. 46.

534. MOON, S. B. The Growth of Boys. *Amer. Ass'n for the Adv. of Phys. Educ.*, 1896, 19-23.

A brief article giving the measurements in a percentile table for 150 boys who are measured annually from 11 to 15 years of age.

535. MOON, S. B. *The Growth of Boys.* Concord, N. H.; Repub. Press Ass'n. 1896. Pp. 9.

The 50 percentile boys, 11-15 years of age, are compared with Seaver's 50 percentile Yale man in 30 measurements. Two charts are given.

536. MOON, S. B. The Question of Growth at Puberty. *Amer. Phys. Educ. Rev.*, 1899, (4), 294-298.

Data are given with a view to testing Bowditch's law specifically in regard to retardation before pubescent acceleration. The law is not satisfactorily confirmed. It is concluded that "pubertal attainment has but little, if any, effect upon the rate of growth, at least in many cases."

537. MOORE, A. W. AND BEDDOE, J. Physical Anthropology of the Isle of Man. *J. Anthropol. Inst.*, 1897-98, (27), 104-130.

538. MOREY-ERRANT, D. Unity of the Periods of Growth in Man. *Trans. of Ill. Soc. f. Child Study,* 1898, (4), 84-91.
A general discussion bearing primarily on puberty.

*539. MORSE, W. H. The Baby's Growth. *Va. Med. Mo.,* 1886-87, (13), 392-395.
A brief study of the weight of infancy, showing the comparative stages of physical development.

540. MORSKOI, B. *Russian Naval Collections.* St. Petersburg: 1871, (12).
Contains the results of the physical examination of recruits in 1869 and 1870.

*541. MÜHLMANN, M. Über Wachstumserkrankungen. *Jahrb. f. Kinderheilk.,* 1910, (70), 174-208.
Remarks on diurnal fluctuations in weight. Eighteen individual charts from daily weighings of infants during the first seven to 11 days and in a few cases as far as 2½ months, with data on feeding, illness, etc., show fairly regular fluctuations in weight.

542. MULLER, G. Alphonse Bertillon's Method for the Identification of Criminals; Instructions For Taking Measurements and Descriptions. *Anthropometric Identifications,* 1887, (8), 84.
A practical guide for criminologists.

543. MUMFORD, A. A. Physique of the Modern Boy. *Manchester Lit. and Philos. Soc.,* 1912.
This deals with the development of Manchester grammar school children.

544. MÜNCH, L. Die Pirquet'sche Messtafel über Alter, Länge und Gewicht des Kindes. *Österr. San-Wes.,* 1914, (26), 1267-1269.
This contains two tables giving the height and the weight of children more than 3 cm. and more than 2 kgm. below the normal at each age.

545. MYERS, C. S. Contributions to Egyptian Anthropometry. The Comparative Anthropometry of the Most Ancient and Modern Inhabitants. *J. Anthropol. Inst.,* 1905, (35), 80-91.

546. MEYERS, C. S. Measurements of Egyptian Recruits. *J. Anthropol. Inst.,* 1906, (36), 237.

547. MYERS, C. S. Contributions to Egyptian Anthropology. *J. Roy. Anthropol. Inst. Gr. Brit. and Irel.,* 1908, (38), 99-147.

548. NAGORSKY,— *(The Influence of Schools on the Physical Development of Children.)* St. Petersburg: 1881.
Russian, cited by Sack.

549. NICEFORO, A. Note préliminaire d'anthropologie sur 3147 enfants des écoles de Lausanne étudiés en rapport à leur condition sociale. *Scuola positiva,* Roma: 1903, 2 s., (1), 257; 412.

550. NICOLAS, L. Historia de Anthropología Física en México. *Amer. J. Phys. Anthropol.,* 1919, (2), 229-264.

551. NIEUWENHUIS, A. W. *Anthropometrische Untersuchungen bei den Dajak.* Haarlem: Kohlbrugge, 1903. Pp. 20.

*552. NIKES,— *Abhängigkeit des Geburtsgewichtes der Neugeborenen vom Stand und der Beschäftigung der Mutter.* Diss. Strassburg: 1902.
Includes weight of infants measured 1896-1901.

553. NORSWORTHY, N. *The Psychology of Mentally Deficient Children.* Columbia Univ. Contrib. to Phil. and Psych. New York: Columbia Univ., 1906, (15), No. 2.
This is an extensive investigation of certain mental and physical traits in 138 feebleminded boys and girls. When the meas-

urements of height and weight were compared with the Boas and Bowditch standards for normal children, the feebleminded were found to be indistinguishable from ordinary children.

*554. ODIER,— *La loi d'accroissement des nouveau-nés.* Paris: 1863.

555. OEDER, G. Das Körpergewicht des erwachsenen Menschen bei normalem Ernährungszustand und seine Berechnung. *Zsch. f. Versicherungs-med.*, 1909, (2), 2-12; 33-41.
In this article Oeder develops a formula based on 2000 cases, in which body weight in kilograms is equal to body length in centimeters minus 100. Five graphs and an explanation of the exceptions to this rule complete the article.

556. OEDER, G. Über die Brauchbarkeit der proportionellen Körperlänge als Massstab für die Berechnung des Körpergewichts erwachsener Menschen bei normalem Ernährungszustand. *Med. Klin.*, 1909, (5), 460-465.
The subject matter of this, as of the other articles here referred to, is the discussion of the validity of the writer's formula. In this article he deals with 24 men and women and tries to define what is the normal condition of nutrition.

557. OEDER, G. Körpergewicht und Körperlänge. *Zsch. f. Versicherungs-med.*, 1910, (3), 138-141.
This is a more popular and briefer statement of the article in Vol. 2 of the same Zeitschrift. The formula is restated with the reservation that stature must be multiplied by twice the distance "vom Scheitel zur Symphysenmitte." With this reservation he finds his formula covers 98% of the male and practically all of the female cases.

558. OEDER, G. Körpergrösse und Körpergewicht des Menschen. *Dtsch. med. Woch.*, 1914, (40), 917-918.
This is principally a discussion of Schwiening's works.

559. OEDER, G. Die Gaertner'sche Normalgewichtstabelle für Erwachsene. *Berl. klin. Woch.*, 1915, 1086-1092.
A critical discussion of formulae for determining volume, specific gravity, etc. Comparative tables of 281 adults show the inadequacy of Gaertner's formula.

*560. OKAMATO, R. (Body Weight and Height of Japanese Babies). *Tokyo med. Woch.*, 1894, No. 839, 3-6.

561. OKER-BLOM,— Om Längd- och Viktförhallandena hos Eleverna vid Helsingfors Folkskolor. *Finska lak. handl.*, 1912, No. 1.

*562. OPITZ, H. (Growth and Development of Underweight New Born Children.) *Monatsch. f. Kinderheilk.*, 1914, (13), 3.

563. OPPENHEIM, N. *Development of the Child.* New York: Macmillan Co., 1898, 1-92.
A good general treatment of growth, without statistics or original measurements.

564. OPPENHEIMER, K. *Über die Wachstumsverhaltnisse des Korpers und der Organe.* München: 1888.

*565. OPPENHEIMER, K. Über das Verhältnis des Nahrungsbedarfes zu Körpergewicht und Körperoberfläche bei Säuglingen. *Zsch. f. Biol.*, 1901, (42), 147-160.
This shows by 20 observations on three children, that the calculation of the nutritional requirements of infants should be based on surface measurements as well as on weight.

566. ORENSTEEN, M. M. Correlation of Anthropometrical Measurements in Cairo-born Natives. *Biometrika*, 1915-17, (11), Parts 1 and 2, 67-81.
Length and breadth of head, length of left middle finger,

length of left foot, length of left cubit are reported for 802 adult native Egyptians (prisoners). The coefficients of correlation between all parts measured are found to be significant.

*567. ORSCHANSKY,— *Die Vererbung im gesunden und kranken Zustande.* 1903, 157.
Reports the birth measurements of 171 boys and 178 girls of Charkow.

*568. ÖRUM, H. P. T. *Vaegtsvingninger hos det spaede Barn.* Reprint from the *Nordisk Tidsskrift for Terapi,* 1914. Pp. 10.
This is an investigation of the growth in weight of 725 breast-fed children to establish normal weight curves for Danish infants. The author reviews earlier works on the weighing of infants, including many little known ones, but unfortunately gives no specific references. His weight curves are compared with those of Camerer. The author finds a seasonal variation in weight increase.

569. ÖRUM, H. P. T. Om Vejning og Maaling af Skoleborn. *Tidsskrift for Dansk Skolehygiejne,* 1919, (7), No. 10, 77-82.
A thorough discussion of methods for the mathematical treatment of statistics of physical measurements, including an evaluation of the formulae of Livi, Pignet, von Pirquet and Rohrer.

570. OSCHMANN,— Der Einfluss der Kriegskost auf die Schulkinder. *Zsch. f. Schulgesundheitspf.,* 1917, (30), 49-59.
Measurements were made of 161 girls and 169 boys 6-11 years of age in the school years 1913-14, 1914-15, 1915-16. The average weight and height showed a slight decrease as the war went on. The weight and height of children entering the elementary school in 1915 and in 1916 also showed a slight unfavorable influence of war conditions. The writer concludes that this influence is insignificant compared with the effect of neglected children's diseases.

571. OTT,— Das Pignet'sche Verfahren bei der Aushebung. *Dtsch. militärärzl. Zsch.,* 1911.
Tried out Pignet's formula on recruits and considers it valuable for a rapid survey of recruits.

572. ÖVERLAND,— Pirquet-undersökelser paa Barn. *Med. Revue,* 1913, 1.

573. PAGLIANI, L. Sopra alcuni fattori dello sviluppo umano-richerche anthropometriche. *Atti del. r. Accad. di sci. di Torino,* 1875-76, (11), 694-760. Also *Arch. di Anthrop. ed etnol. italiana,* 1876, (6), 129-183.
These children were examined and measured in Turin and the accompanying tables give the effect of growth under favorable and under less favorable conditions, together with the effect of exercise on the development of the lung capacity of boys.

574. PAGLIANI, L. Lo sviluppo umano per eta, sesso, condizione sociale e etnica studiato nel peso, statura, circonferenza toracica, capacita vitale e forza muscolare. *Giornale del. Soc. ital. d'igiene,* 1879, (1), No. 4, 357-376; No. 5, 453; No. 6, 589-608.

575. PEARSON, K. Growth of St. Louis Children. *Nature,* 1894, (51), 145-146.
In this investigation Pearson summarizes Galton's percentile methods and says that it is now acting as a distinct hindrance to statistical theory in an unexpected way, since it does not require the investigator to publish his raw material. A criticism is given of Porter's work on this basis, since the material is only given in the form of percentiles or in diagrams of the "ogive" curve corresponding to the integral of the frequency curve.

*576. PEARSON, K. On the Correlation between Weight and Length of Infants at Birth. *Proc. Roy. Soc.*, 1900, (66), 24.

The examination of 1000 male and 1000 female babies (twins excluded) born at the normal period at the Farrbelt Lying-In Hospital showed that the male at birth was larger and more variable than the female at birth. Both sexes lose variability and correlation when they become adult.

See also PEARSON, K. On the Handicapping of the First Born. Eugenics Lecture Series X. Cambridge, England: Cambridge University Press.

Gives the weight and length of newly born babies according to their place in family.

577. PEARSON, K. On the Correlation of Intellectual Ability with the Size and Shape of the Head. *Proc. Roy. Soc.*, 1901-02, (69-70), 333-342.

Length of head, breadth of head and cephalic index show very small correlations with intellectual ability as shown by college honors in the case of Cambridge men.

578. PEARSON, K. On the Laws of Inheritance in Man. II. On the Inheritance of the Mental and Moral Characters in Man, and Its Comparison with the Inheritance of the Physical Characters. *J. Anthropol. Inst.*, 1903, (33), 179-237. Also *Biometrika*, 1904, (3), 131-190.

Gives for stature, span and length of forearm the size and variability of each character in two generations and the parental, fraternal and assortative mating coefficients of correlation.

579. PEARSON, K. On the Relationship of Intelligence to Size of Head and to Other Physical and Mental Characters. *Biometrika*, 1906, (5), 105-146.

Head measurements of 1000 Cambridge graduates with examination standing of each. Also measurements of 5000 school children and an intellectual rating. Such small correlations were found between head measurements and intelligence as to be of no service for the purposes of prediction.

580. PECKHAM, C. W. The Growth of Children. *Rep. of Wis. Bd. of Health*, 1881, (6), 28-73.

About 10,000 children in the various schools of Milwaukee were measured and examined in 1881 (ages from four to 18 years). Eleven plates and 13 tables giving the rates of growth by nationality are included.

581. PECKHAM, C. W. Various Observations on Growth. *Rep. of Wis. Bd. of Health*, 1882, (7), 185-188.

This investigation showed that there were certain important differences in the rates of growth of Boston children and Milwaukee children.

582. PEIPER, E. Ein Beitrag zur Frage der körperlichen Entwicklung der Schuljugend. *Zsch. d. Zentrale f. Volkswohlfahrt "Concordia"*, No. 1, 1911.

583. PEIPER, E. Körperliche Entwicklung der Schuljugend in Pommern. *Arch. f. soz. Hyg.*, 1912, (7), 109-137.

For this study 14,194 city children and 28,334 country children were measured in height, weight and chest circumference. Comparative tables are given from other investigators. Country boys are found to be better developed with respect to all three measurements.

*584. PELLER, S. Der Einfluss sozialer Momente auf den körperlichen Entwicklungszustand der Neugeborenen. *Österr. San.-Wes.*, 1913, (25), Beiheft V, 1-47.

This is a study of the effect of prenatal care on the weight of the child. Over 4,000 cases were studied in relation to various factors.

*585. PELLER, S. Längengewichtverhältnis der Neugeborenen und Einfluss der Schwangerernährung auf die Entwicklung des Fötus. *Dtsch. med. Woch.*, 1917, (43), 847.

586. PENN, B. A Schoolmaster's Notes on the Growth of Scholars. *Sch. Hygiene*, London, 1917, (8), 116-122.

The writer measured 117 children in a school in London (ages 7½ to 12½) and compared their development with that of children from the south of England.

*587. PERRET,— AND PLANCHON,— Établissement de la courbe de poids des nourrissons, pendant la seconde année. *L'obstetrique*, 1904, (9), 193-203.

This contains a table showing the average weight for each week of the second year (72 subjects). At first the curve ascends very little, forming a sort of plateau, thought to be due to change of diet at the time of weaning.

*588. PETERSSON,— Über die Gewichtsverhältnisse bei Kindern im ersten Lebensjahre. *Upsala Läkareförenings forhandl.*, 1887, (18).

*588a PFANNKUCH, W. Über die Körperform der Neugeborenen. *Arch. f. Gynäk*, 1872, (4).

Study of 714 infants, including weight, length and circumference of head.

*589. PFAUNDLER, M. Körpervolum- und Körperdichtbestimmung am lebenden Säugling. *Zsch. f. Kinderheilk.*, 1911-12, (3), 413-427.

This consists of remarks on Kastner's article and further analysis of the technique necessary for these determinations.

590. PFAUNDLER, M. Körpermass-Studien an Kindern. *Zsch. f. Kinderheilk.*, 1916-17, (14), 1-148.

A detailed consideration and mathematical criticism of some of the previous work on growth. The article has six parts dealing respectively with: (1) Variations in stature; (2) Differences in physical measurements as dependent on social class; (3) Growth curves and formulae; (4) The body surface; (5) The law of equal heat radiation for equal body surfaces; and (6) Body volume and density.

*591. PFEIFFER, E. Bemerkungen betreffend Wachstum und Körperwägungen der Säuglinge. *Jahrb. f. Kinderheilk.*, 1884, (19), 142-147.

The average weight of infants 1-12 months was calculated for nine cases and found to coincide with Bouchaud's findings. The writer gives instances of individual infants whose weight increase does not coincide with Fleischmann's rule that the child at the end of five months weighs twice its first weight plus 550 grams.

592. PFITZNER, W. Social Anthropologische Studien. I. Der Einflusz des Lebensalters auf die anthropologischen Charaktere. *Zsch. f. Morph. u. Anthropol.*, 1899, (1), 325-377.

Contains several tables of growth.

593. PFITZNER, W. Social Anthropologische Studien. II. Der Einflusz des Geschlechts auf die anthropologischen Charaktere. *Zsch. f. Morph. u. Anthropol.*, 1901, (3), 485-575.

Gives several tables of absolute measurements on 2233 men and 1725 women.

594. PFITZNER, W. Social Anthropologische Studien. III. Der Ein-

flusz der socialen Schichtung auf die anthropologischen Charaktere. *Zsch. f. Morph. u. Anthropol.*, 1902, (4), 31-98.
Contains several tables showing the physical peculiarities of the various social classes.

595. PFITZNER, W. Social Anthropologische Studien. IV. Die Proportionen des erwachsenen Menschen. *Zsch. f. Morph. u. Anthropol.*, 1903, (5), 201-314.
Includes many tables showing the correlation between different measurements.

*596. PHILIPPSON, P. Über die Entwicklung junger Säuglinge bei künstlicher Ernährung. *Monatsch. f. Kinderheilk.*, 1913, (12), 157-176.

*597. PIES, W. Über die Dauer, Grösze und den Verlauf der physiologischen Gewichtsabnahme bei Neugeborenen. *Physiologie des Neugeborenen*, 1910.
Out of 150 infants 96 reached their birth weight by the 22nd day.

598. PIGNET,— Valeur numerique de l'homme. Nouveau mode d' appreciation de la force physique exprimée par un nombre tiré de la comparaison des trois mensurations: taille, périmètre et poids. *Arch. méd. d' Angers*, 1900, (4), 453-461.

599. PIGNET,— Du coéfficient de robusticité. *Bull. méd.*, April 27, 1901, No. 33.
Here Pignet explains the significance of his formula for combining height, chest circumference and weight into an index, whose size correlates inversely with increased degrees of physical development. He makes practical use of eight index classes, which give a range from individuals who are over-developed, to those who are weaklings.

600. v. PIRQUET, C. F. Eine einfache Tafel zur Bestimmung von Wachstum und Ernährungszustand bei Kindern. *Zsch. f. Kinderheilk.*, 1913, (6), 253-262.
A chart with curves constructed by reducing the average height and weight (according to Camerer) for each year to a single point, the curve being drawn through these points to represent the development of the average child from birth to 14 years. Camerer's figures have also been arranged in a table of height and weight and values interpolated to permit of finer grading. The article emphasizes the necessity of determining the nutritional condition of a child by comparing its weight, not with the weight for that year, but with the height.

601. v. PIRQUET, C. F. Sitzhöhe und Körpergewicht. *Zsch. f. Kinderheilk.*, 1916, (14), 211-228.
Measurements were made of 128 new born, 54 premature and a number (not stated) of children up to 20 years of age. These are not consecutive measurements on the same individuals, but they show a constant relationship between the cube root of the weight or the cube of ten times the weight, and the sitting height. This index the writer considers a good measure of the nutritional condition of the individual. In normal adults its value approximates 100; in a growing child 94; in conditions of emaciation 81.

602. PISMENNRY, N. H. (Comparison of the Physical Development of Pupils of the Factory and Public Schools of Serpukhor Co., as Related to the Several Conditions of Life of the Factory Population.) *Vestnik. obsh. hig. sudeb. i. prakt. med.*, St. Petersburg: 1905, 506-524.
Russian.

603. PITTARD, E. Influence du milieu géographique sur le développe-

ment de la taille humaine. *Compt. rend. acad. d. sci. Paris*, 1906, (143), 1186-1188.

604. PITTARD, E. Comparaison de quelques caractéres somatologiques chez les Turcs et les Grecs. *Rev. anthropol.*, 1915, (25), 446-454.
The writer finds a close relationship morphologically between the Greeks and the Turks. A few tables are included.

605. PITTARD, E. Ftude anthropométrique des Juifs de Dobrodja. *Rev. anthropol.*, 1915, (25), 139-149.
A study of 74 male subjects, with a few tables. The conclusion is drawn that this group does not resemble the true Jews in its morphological characteristics.

606. PITTARD, E. Anthropométrie comparative des populations balkaniques. *Compt. rend. acad. d. sci. de Paris*, 1915, (160), 642-645; 681-685.
Brief remarks reporting the average height, head size, and various indices of several races in the Balkan peninsula. No tables of growth.

607. POETTER,— Messungen und Wägungen von Leipziger Schulkindern im Kriege verglichen mit der Friedenzeit. *Zsch. f. Schulgesundheitspf.*, 1919, (32), 49-57.
Measurements of weight, height and chest circumference made during March, 1917, and February, 1918, compared with normal measurements made in Leipzig in February, 1914. The measurements of children seven to 14 years were averaged for each year period, 3697 children being measured in all. The average weight at all ages was found to have decreased since the war, by one-half to three and one-half kilograms. Average height showed less decrease while chest circumference actually increased in the two war years. Six tables and one graph.

*608. POLLAK, L. Die Entwicklung der Säuglinge während des Krieges. *Wien med. Woch.*, 1918, (68), 1044-1049.

*609. POOLER,— *Sixth An. Rep. Birmingham Infants Health Soc.*, 1913.
This article, cited by Robertson, contains norms derived from the measurement of British infants.

610. POPPER, J. Über den Zusammenhang zwischen Genie und Körpergrösse. *Polit. anthropol. Rev.*, 1907, (7), 485-492.

611. PORTER, W. T. On the Application to Individual School Children of the Mean Values Derived from Anthropological Measurements by the Generalizing Method. *Amer. Statis. Ass'n.*, 1892-93, (3), n. s., 576-587.
A discussion of the significance of deviations above or below normal height and the requirements of a proposed system of physical measurements.

612. PORTER, W. T. Untersuchungen der Schulkinder in Bezug auf die physischen Grundlagen ihrer geistigen Entwicklung. *Verhandl. d. Berl. anthropol. Gesellsch.*, 1893, 337-354.
A translation of the former article.

613. PORTER, W. T. The Physical Basis of Precocity and Dullness. *Trans. Acad. of Sci. of St. Louis*, 1893, (6), 161-181.
In this investigation, which is based on the previous one, Porter gives 15 tables and two charts, tracing the development by age of dull, mediocre and precocious boys and girls and maintains that "Precocious children are heavier and dull children are lighter than mean children of the same age."

614. PORTER, W. T. The Relation Between the Growth of Children and Their Deviation from the Physical Type of Their Sex and Age. *Trans. Acad. of Sci. of St. Louis*, 1893, (6), 263-280.

In this investigation Porter compares the growth of the school children in Freiburg with those in St. Louis and concludes: "The psychological difference between the individual children in an anthropometric series and the physical type of the series is directly related to the quickness of growth."

615. PORTER, W. T. The Growth of St. Louis Children. *Amer. Stat. Ass'n* (quarterly), 1894, (4), n. s., 28-34. Also *Acad. of Sci. of St. Louis*, 1894, (6), 263-380.

This is one of the most significant investigations so far made, including measurements in height, weight and span of arms, strength, girth, measurements of face and head, based on 34,354 children. A careful discussion of the statistical measurements is included. There are 51 tables given in percentile grades and 46 plates. References are appended.

616. PORTER, W. T. Anthropometrical Measurements in Schools. *Educ. Rev.*, 1896, (11), 126-133.

A practical discussion of the study of physical growth from the educational standpoint.

617. PORTER, W. T. Remarks on the Use of Anthropometrical Instruments in Schools. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1896, 158-164.

In this article Porter bases his discussion on the fact that "the average or other central value of the group of properly related measurements gives an idea of the character of the group." Emphasis is laid on types, and we are told that percentile grades can not be used as yet for prediction of future size.

It is recommended that the annual record of the height and weight of every pupil be kept, and that all pupils, whose weight and weight ratio is above the 75 or below the 25 percentile grade of their age, be placed under special supervision in order that they may not be overtaxed by the work required of normal pupils.

618. PORTER, W. T. Seasonal Variations in the Growth of Boston School Children. *Amer. J. of Physiol.*, 1920, (52), 121-131.

Presents data and curves to show seasonal variations in the weight of several thousand children. The same children were weighed every school month from 1909 to 1919. The increase in weight from January to June each year was found to be less than from September to December. This difference was apparently not due to the weight of clothing. The article includes a discusion of the superiority of the individualizing method.

619. PORTEUS, S. D. Cephalometry of Feebleminded. *Train. Sch. Bull.*, 1919-20, (16), 49-72.

A good review of the literature with results on 50 unselected cases. Six tables and five graphs permit of comparison with the percentile tables of the Berry-Porteus investigation of normal individuals. It is concluded that striking deviations from the normal in brain size tend to be associated with mental abnormality. In some measurements, 50% of the feebleminded group differed markedly from the normal. See also an earlier report, *Train. Sch. Bull.*, Oct. 1918, 11.

620. POULTON, E. P. The Relation between Body Weight and Body Length. *Guy's Hosp. Gaz.*, 1917, (31), 50-52.

621. POWYS, A. O. Data for the Problem of Evolution in Man. *Biometrika*, 1902, (1), 31-49.

A mathematical treatment with graphs of the data on Australian criminals, including a discussion of stature between the ages of 15 and 85 and the alteration of stature with old age.

622. Pyle, W. H. *The Examination of School Children.* New York: Macmillan, 1913. Pp. 67.
This contains directions for taking measurements and tables of norms from Smedley and Kotelmann.

623. Pyle, W. H. A Manual for the Mental and Physical Examination of School Children. *Univ. of Missouri Extens. Bull.,* No. 29. Columbia, Mo.: Univ. of Mo., 1920, (21). Pp. 39.
Contains some new norms on country and city children.

624. Pyle, W. H. and Collings, P. E. The Mental and Physical Development of Rural Children. *Sch. & Soc.,* Nov. 2, 1918, (8), 534-539.
Over 2000 children in an entire county of the state of Missouri were measured and compared with the norms in Pyle's manuals of 1913 and 1916. Comparisons are made of country and city children, showing slight differences only, in physical development though city children are a little better developed.

625. Pyle, W. H. A Study of the Mental and Physical Characteristics of the Chinese. *Sch. & Soc.,* 1918, (8), 264-269.
Comparison of height (standing and sitting), weight, lung capacity, grip, muscular speed, length and breadth of head, are reported, showing the physical measurements of the Chinese in terms of their percentages of the corresponding measures of American children. In general, Chinese children are found "to be physically inferior to American children of the same age." No estimate is made as to how much this is due to racial type.

626. Quetelet,— Sur la taille de l'homme dans les villes et dans les campagnes. *Ann. d'hyg. et de méd. lég.,* 1830.

627. Quetelet, M. A. Recherches sur le poids de l'homme aux différents âges. *Acad. roy. d. sci. d. lettr. et d. beaux-arts de Belgique,* 1832-34, (1), 20-24.

628. Quetelet, M. A. *Sur l'homme et le développment de ses facultes, ou essai de physique sociale.* Paris: Bachelier, 1836.
Pioneer work in the field of anthropometry, which studies records from the standpoint of an artist as well as a scientist.

629. Quetelet, M. A. Sur les Indiens Ojib-be-was et les proportions de leur corps. *Acad. roy. d. sci. d. lettr. et d. beaux-arts de Belgique,* 1846, (13), 70-76.
A brief scientific study of three Indians.

630. Quetelet, M. A. Sur les proportions des hommes qui se font remarquer par un excès ou un défaut de taille. *Acad. roy. d. sci. d. lettr. et d. beaux-arts de Belgique,* 1847, (14), 138-142.
A short summary with references to Ojib-be-was Indians.

631. Quetelet, M. A. Des proportions du corps humain. *Acad. roy. des sci. d. lettr. et d. beaux-arts de Belgique,* 1848, (15), 16-27.
A discussion of the Egyptians, Romans, and Indians.

632. Quetelet, M. A. Sur les proportions de la race noire. *Intern. Cong. f. Sch. Hyg.,* 1854, (21), 96.

633. Quetelet, M. A. *Anthropométrie au mesure des différentes facultés de l'homme.* Bruxelles: 1870.

634. Quetelet, M. A. *Sur l'homme et Anthropométrie.* Brüssel: 1870.

635. Quirsfeld, E. Vorträge: Zur physischen und geistigen Entwicklung des Kindes während der ersten Schuljahren. *Intern. Cong. f. Sch. Hyg.,* 1904, (3), 128-134.
A careful study of the physical conditions of children during the first years of school, followed by a discussion by F. A. Schmidt, E. Bayr, and Frau Dr. Krukenberg.

636. Quirsfeld, E. Zur physischen und geistigen Entwicklung des

Kindes während der ersten Schuljahren. *Zsch. f. Schulgesundheitspf.*, 1905, (18), 127-185.

This is a preliminary report which is to include yearly measurements of the same group of boys and girls from the 6th through the 14th year. So far measurements have been obtained for years 6-10, of height, chest circumference, vital capacity, weight, muscular strength, together with observations on nutrition, scolioses, vision, ear disease, etc.

637. QUIRSFELD, E. Untersuchungsergebnisse physischer und geistiger Entwicklung bei 1014 Kindern vom 1 bis 8 Schuljahre. *Prag. med. Woch.*, 1907, (32), 653-656. Translation in *2nd Intern. Cong. Sch. Hyg.*, London: 1907, 214-216.

A study of physical and mental development in early childhood.

638. RADLAUER, C. Anthropometrische Studien an Somali (Haschia). *Arch. f. Anthropol.*, 1914-15, n. F., (13), 451-473.

Head measurements and body measurements, 47 in all, are given for 35 subjects, aged five to 35 years.

639. RADOSAVLJEVICH, P. R. Pedagogical Measurements of Pupils in Mostar, Herzegovina (Austria). *Proc. 4th Intern. Cong. for Sch. Hyg.*, Buffalo: 1913, (5), 541-550.

A large number of pupils of elementary and secondary schools were measured in standing and sitting height, weight and six head measurements. Six tables are given. The usual growth phenomena are traced, but little correlation is noted between physical dvelopment and school brightness.

640. RAMBUSCH,— Skolebörnenes Fysikalske forh. i nogle Midtjydske Sogne. *Medd. Danmarks Anthropologi*, 1907-11, (1), 173.

*641. RAMSEY, W. R. AND ALLEY, A. G. Observations on the Nutrition and Growth of New Born Infants; 300 Clinical Charts. *Amer. J. Dis. Child.*, 1918, (15), 408-412.

This is an analysis of 300 clinical charts which gives information in regard to the average birth weight, caloric intake, initial loss of weight, etc. No tables of growth.

642. RANKE, A. E. Anthropologische Betrachtungen aus Zentralbrasilien. *Abhandl. d. k. bayr. Akad. d. Wissensch.* München: 1906, II Kl., (24), 1. Abteilg.

643. RANKE, J. Zur Statistik und Physiologie der Körpergrösse der bayerischen Militärpflichtigen in den 7 rechts-rheinischen Regierungsbezierken nach den Vorstellungslisten der Kgl. Ober-Ersatzkommissionen vom Jahre 1875. *Beitr. zur Anthropol. u. Urgeschichte Bayerns*, 1881, (4).

644. RANKE, J. *Der Mensch.* Leipzig: Verl. d. bibl. Instit., 1894-1900. 2v.

Chapters II and III of Vol. 2 contain excellent material on growth and many tables from Europe and America.

645. RANKE, J. Beiträge zur Frage des kindlichen Wachstums. *Arch. f. Anthropol.*, 1905, (3), 161-180. See also *Der Mensch.*, (2), 156-157.

A very careful study of about 2500 children, with many measurements and tables.

646. RANKE, J. Anthropometrische Untersuchungen an gesunden und kranken Kindern mit besonderer Berücksichtigung des schulpflichtigen Alters. *Zsch. f. Schulgesundheitspf.*, 1905, (18), 719-745; 816-837.

Measurements of the heads of 1468 boys and 1041 girls from birth to 15 years. A distribution table is given, though the investigator is principally interested in the pathological sig-

nificance of these measurements, especially with regard to hydrocephalus.

647. RASMUSSEN, K. The Anthropology of the Greenland Esquimaux. *Nature*, 1908-09, (79), 311.

*648. RAUDNITZ, R. W. Über Lebensbücher und das Massenwachstum der Säuglinge. *Prag. med. Woch.*, 1892, (17), 66-71; 82-84.
The second part of this article contains a brief account of the derivation of the growth formulae of Quetelet, Bouchaud, Fleichmann, and Russow, and a few original observations on individuals from the writer's practice.

*649. RECHT,— *Über das Mittelgewicht neugeborener Kinder.* Diss. Bonn: 1897.
Includes measurements on children born 1893-1896.

650. REGNIER,— *Des maladies de la croissance.* Paris: 1860.

651. REINUS,— *Über die Wachstumskurve.* Diss. München: 1915.
A mathematical discussion of the curve of growth.

652. RETAN, G. M. The Measure and Development of Nutrition in Childhood. *Arch. of Pediat.* 1920, (37), 32-39.
Emphasizes the fact that the standard of normal development is the relation of height and weight at a given age. Five charts show the distribution of children of different height and weights at ages five to 18 into zones of over-nutrition, excellent nutrition, passable nutrition, and malnutrition.

653. REUTER, F. Beiträge zur Anthropologie Hinterpommerns; Kindermessungen. *Arch. f. Anthropol.*, 1903, (28), 288-388.
A careful experimental study based on 373 children, with many measurements, graphs, and indices.

654. RICHARDS, A. AND LITTLE, B. B. A Proposed Standard Chart to Show the Proportions of American Females. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1896, 30-34.
A detailed chart is given showing relative measurements.

655. RIEBESELL, P. Über die Wachstums- und Ernährungsgesetze des Menschen. *Berl. klin. Woch.*, 1916, Heft 5; 1917, Heft 7.
Weight as a function of time is to be used as an index of physiological age.

656. RIEDEL, E. *Die Körperlänge von Münchner Schulkindern.* Diss. München: Müller & Steinicke, 1913.

657. RIETZ, E. Das Wachstum der Berliner Schulkinder während dem Schuljahre. *Arch. f. Anthropol.*, 1903, (1), 30-42.
This investigation is based on a study of 5134 Berlin boys and girls between the ages of six and 19, and includes the comparison between children from different types of schools. Twelve tables are included and one chart, with corresponding curves for the Gymnasien and Höhere Schulen and the Gemeindeschulen. A comparison is also made between the children of the better classes and the poorer classes at Hamburg, Berlin, Halle, Gohlis, Saalfeld, Stockholm, Denmark, England, Boston, Turin, Warsaw, and Freiberg, as outlined by Burke but less complete, the number of individuals not being included.

658. RIETZ, E. Körperentwicklung und geistige Begabung. *Zsch. f. Schulgesundheitspf.*, 1906, (19), 65-98.
Measurements of weight and height of 20,400 boys, nine to 20 years old, from Höhere Schulen of Berlin, show that brighter children (judged by school progress) are better developed physically. Many tables and curves are given, closely approximating the normal surface. The brighter boys are also heavier for their height than are the more retarded ones.

659. Ripley, W. Z. The Form of the Head as Influenced by Growth. *Science.* 1896, N. S., (3), 888-889.
Measurements of length and breadth of head on 485 Massachusetts Institute of Technology students at the beginning and end of their four years course, show that growth is almost entirely in length, the cephalic index decreasing with age. A few references are given.

660. Roberts, C. Memorandum on Medical Inspection and Physical Education in Secondary Schools. *Rep. Roy. Comm. on Second. Sch. of Eng.*, (5), 352-374.
This report deals primarily with the relation of weight and height to hygienic conditions and the death rate at various ages.

661. Roberts, C. The Physical Development and Proportions of the Human Body. *St. George's Hosp. Rep.* London: 1874-76, (8), 1-48.
This contains tables showing the average height and the annual rate of growth of English males. Similar tables are given for chest girth, weight, weight-height coefficient, and for various proportions of the body.

662. Roberts, C. The Physical Requirements of Factory Children. *J. of Statis. Soc.*, 1876, (39), 681-733.
An excellent study, including height, weight, and chest girths. Comparisons are made with Quetelet's data.

663. Roberts, C. *Manual of Anthropometry.* London: Churchill, 1878. Pp. 118.
This is an important manual containing much anthropometric material and many references. The height, weight, and annual increments of 7709 boys and men of favored class between 10 and 30 are included. There are also many other tables, one including height, weight and chest girth of new-born infants; another of the average height, weight and chest girth of the artisan class between the ages of four and 50. A careful comparison is made with Bowditch's work in Boston.

664. Robertson, T. B. On the Normal Rate of Growth of an Individual and its Biochemical Significance. *Arch. f. Entwicklungsmech.*, 1897, (25), 581-614.
From the results of the British Anthropometric Committee and of Quetelet the author derives a growth formula which he shows to hold true for plants as well. He believes growth to be an autocatalyzed process.

*665. Robertson, T. B. The Post-natal Loss of Weight in Infants and the Compensatory Overgrowth Which Succeeds It. *Proc. Soc. Exper. Biol. & Med.*, 1914, (12), 66. Same title, *Amer. J. Physiol.*, 1915, (37), 74-85.

*666. Robertson, T. B. The Post-natal Loss of Weight in Infants and the Compensatory Overgrowth Which Succeeds It. *Amer. J. Physiol.*, 1915, (37), 74-85.
This is a study of the average weights of over a hundred Australian infants. The treatment is mathematical and theoretical, the loss phenomena being attributed to mechanical shock during delivery.

*667. Robertson, T. B. A Comparison of the Weights at Birth of British Infants Born in the British Isles, the U. S. and Australia. *Univ. of Cal. Publ. Physiol.*, Berkeley: Univ. of Cal., 1915, (4), No. 20. Pp. 4.

*668. Robertson, T. B. Pre- and Post-natal Growth of Infants. *Amer. J. Physiol.*, 1915, (37), 1-42.
This is a mathematical treatment of growth cycles with tables

and graphs showing the observed and the calculated weights of 251 infants from birth to one year (not the same infants followed throughout). It appears that Australian infants are considerably heavier at first than are British infants.

*669. ROBERTSON, T. B. The Growth of British Infants During the First Year Succeeding Birth. *Amer. J. Physiol.*, 1916, (41), 535.

Carefully collected records of the average weight of 2129 English infants 1-12 months of age are given in five tables and two graphs. These show that Newman's standard (derived from French infants) is too low. The variability of male infants is greater than that of females and the variability is greatest when the velocity of growth is greatest. Calculated growth curves by Robertson's formula are found to agree closely with observed curves.

669a Also The Variability of the Weight and Stature of School Children and Its Relationship to Their Physical Welfare. *Amer. J. Physiol.*, 1916, (41), 547-554.

The records of 50 boys and 50 girls, 6-14 years inclusive, from the schools of Oakland, Calif., were selected at random. The results given in four tables and two graphs show that the rate of growth in weight increases continuously and that the variability in weight undergoes a parallel increase. Stature, on the other hand, increases at an almost uniform rate and the variability of stature is correspondingly uniform. An unfavorable environment operates to decrease both stature and weight, but to increase the variability of stature while decreasing the variability of weight.

*670. ROEDERER,— De pondere et longitudine infantum recens naturum. *Commentaries of the Roy. Soc. of Göttingen*, 1753.

This is a report of measurements of height and weight of 27 new born children.

671. ROHRER, F. Eine neue Formel zur Bestimmung der Körperfülle. *Korr.-Bl. Ges. f. Anthropol.*, 1908, (39), 5.

672. RÖSE, C. Beiträge zur europaischen Rassenkunde. *Arch. f. Rass.- u. Gesellschaftsbiol.*, 1905, (2), 689-798.

Subjects for this study were mostly German school children. Head and face measurements are reported in 73 tables.

673. ROSHDESTWENSKY, A. (Die Kopfgrösze des Menschen in ihrer Beziehung zu Höhe, Geschlecht, Alter u. Rasse.) *Arbeit. d. anthropol. Abt., Moskau*: 1897, (18).

Russian.

674. ROSTOVTSEV, G. J. (Anthropological Study of Children in Schools of District of Dmitrovsk.) *Med. besieda*, 1900, (14), 184-191.

Russian.

675. ROTCH, T. M. Roentgen-Ray Methods Applied to the Grading of Early Life. *Amer. Phys. Educ. Rev.*, 1910, (15), 396-420.

An address with seven photographs and three tables, showing briefly the writer's discoveries on the development of the wrist bones and putting forth the thesis that school grading should be on the basis of anatomic development. Particular stress is laid on the danger of overstraining the nervous system of the bright child with the work of the higher grades before the development of the osseous system shows the child to be sufficiently mature for such work.

676. ROTCH, T. M. A Comparison in Boys and Girls of Height, Weight and Epiphyseal Development. *Trans. Amer. Pediat. Soc.*, 1910, (22), 36-38.

No tables are given, but a graph shows the height and weight

(according to Camerer) and epiphyseal development of boys and girls (500 cases). Whereas the girls' height and weight curves start lower than those of the boys, cross at 12 to 13 years, and are again crossed by the boys' curves at 17 to 18 years, the girls' curve of epiphyseal development is throughout life on a higher level than that of the boys.

*677. ROTT,— Beitrag zur Wesenerklärung der physiologischen Gewichtsabnahme des Neugeborenen. *Zsch. f. Kinderheilk.*, 1910, (1), Heft 1.

678. ROUDENKO, M. S. Resultats de mensurations anthropologiques sur les peuplades du nord-ouest de la Sibérie. *Bull. et mem. soc. d'anthropol. de Paris*, 1914, 6 S., (5), 123-143.
This contains 14 tables and a bibliography of 32 titles.

*679. RÜBNER, M. Wachstum und Ernährung. *Festschr. z. Eröffn. d. k. Auguste Victoriahauses z. Bekampf d. Säuglingssterbl.* Berlin: 1909, 49-56.

*680. RUSSOW, A. Vergleichende Beobachtungen über den Einfluss der Ernährung mit der Brust und der künstlichen Ernährung auf das Gewicht und den Wuchs (Länge) der Kinder. *Jahrb. f. Kinderheilk.*, 1881, (16), 86-132.
This contains a good résumé of the early literature. Determinations of the weight and height of infants with artificial and breast feeding were made with 184 cases for the average of each month to the end of the first year. Detailed comparisons are given with the figures of Bouchaud and Fleischmann. The writer also measured 900 children 1-8 years and found that the maximal weight and height occurred only with children who had been exclusively breast fed during the first year.

681. SACK, N. *(Die physische Entwicklung der Kinder in den Moskauer Mittelschulen.)* Moskau: 1892.

682. SACK, N. *Brustdurchmesser und das Kòrpergewicht der Knaben in den Hoheren Schulen Moskau's.* Aus dem Russischen übersetzt von Prof. Dr. Erismann, 1892.

683. SACK, N. Über die körperliche Entwicklung der Knaben in den Mittelschulen Moskau's. *Zsch. f. Schulgesundheitspf.*, 1893, (6), 649-663.
A very important study containing many references to the work of others, and comparative tables.

684. SACK, N. (Data on the Characteristics of the Physical Development of Children, Diameter of the Chest, and Weight of the Body). *Vestnik. obsh. hig. sudeb. i. prakt. med.*, 1893, No. 1, 2 sect., 1-34.
Russian.

*685. SAKURAGI, J. *Gewichtsverhältnisse von Sauglingen proletetärischer Bevòlkerung bei natürlicher und künstlicher Ernährung.* München: Kastner und Callwey, 1908. Pp. 99.

686. SALOMON,— *Über Messung und Wägung von Schulkindern.* Jena: 1898.

687. SAMOSCH,— Einige bemerkenswerte Ergebnisse von Schulkindermessungen und Wägungen. *Zsch. f. Schulgesundheitspf.*, 1904, Heft 6, (17), 389-403.
Data from 937 boys and 1032 girls, 6-16 years of age, are arranged in eight tables to show the distribution of measures in different school classes and different ages.

688. SANTORI, S. Studio su alcuni indici dello sviluppo fisico e sui rapporti esestenti fra essi, l'agiatezza, l'intelligenza e la condotta; richerchi eseguiti sugli alumni delle scuole elementari del

comune di Roma negli cumi scolastici, 1903-6. *Intern. Arch. f. Schulhyg.*, 1907, (3), 225-242.

689. SARGENT, D. A. Report on the Anthropometric Measurements; A Schedule of Measurements with Directions for Making Them. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1886, (2), 6-15.
A guide for the making and recording of measurements.

690. SARGENT, D. A. The Physical Proportions of the Typical Man. *Scribner's Mag.*, 1887, (2), 3-17.
A semipopular article giving methods of measuring and testing in the physical education of men, with three charts which show at a glance the relation of size, strength, symmetry, and development. These charts have had great influence in laboratories for physical measurements.

691. SARGENT, D. A. The Physical Development of Women. *Scribner's Mag.*, Feb. 1889, 172-185.
A popular article with one table and two graphs showing sex differences in physical measurements.

692. SARGENT, D. A. *Anthropometric Charts for Different Ages, Male and Female, Ranging from 10 to 26 Years of Age.* Cambridge: 1893.
Each chart has a vertical scale for height and weight and a horizontal scale for percentile ratings. Curves are plotted showing the distribution of measurements in the various percentiles above and below the average.

693. SARGENT, D. A. The Physique of Scholars, Athletes, and the Average Student. *Pop. Sci. Mo.*, 1908, (73), 248-256.
A study of 15 groups of men from 18 to 26 years of age, all excepting one group being Harvard students—football players, crew men, strong men, scholarship men, etc. A table of the average height, weight and strength of each group is given, the tallest and heaviest being university crew and football men, the shortest and lightest being "stipend scholarship" men.

694. SAWYER,— STONE,— AND DU BOIS,— Further Measurements of the Surface Area of Adults and Children. *Arch. of Intern. Med.*, (17), 855.

*695. SCANZONI,— (Birth Measurements of Infants). *Lehrb. d. Geburtsh.*, 1849, (1), 95.
Reports the weight of Würzburg infants.

696. SCHADOW, J. G. *Polyclcet oder von den Maassen des Menschen, nach dem Geschlechte und Alter mit Angabe der wirklichen Naturgrösse, &c.* Berlin: 1834.
Interesting from the historical point of view.

*697. SCHAEFFER, O. Über die Schwankungsbreite der Gewichtsverhältnisse von Säuglingen in den ersten 14 Lebenstagen und die Ursachen dieser Schwankungen. *Arch. f. Gynäk.*, 1896, (52), 282-313.
This reports the weight of 592 infants and gives a statistical analysis of various factors that might be the cause of the physiological loss of weight.

*689. v. SCHAETZEL,— *Über den Einfluss des Alters der Mutter und der Zahl der vorausgegangen Schwangerschaft auf Länge und Gewicht des Neugeborenen.* Diss. Greifswald: 1893.

699. SCHERZER, C. AND SCHWARZ, E. Über Körpermessungen als Behelf zur Diagnostik der Menschenrassen. *Mitt. d. Geog. Gesellsch.*, 1859, (3), 11.

*700. SCHICK, B. Ernährungstudien beim Neugeborenen. *Zsch. f. Kinderheilk.* 1917, (17), 1-113.

This is an extensive study of the fluctuation in weight for a few days after birth under the influence of various diets.

701. SCHIFF, F. Anthropologische Untersuchungen an jüdischen Kindern in Jerusalem. *Arch. f. Anthropol.*, 1914, n. f., (13), 348-357.
A study of 604 subjects, but with absolute measurements not recorded.

702. SCHIÖTZ, C. Wachstum und Krankheit. *Zsch. f. Kinderheilk.*, 1915-16, Orig. (13), 393-434.

703. SCHIÖTZ, C. Uproportionert Vekst hos Kvinder. *Norsk. Mag. f.* Laegev., 1916, No. 7.

704. SCHIÖTZ, C. *En Undersokelse av 10,000 Norske Skolebarn Saerlig Med Hensyn Til Vekstforhold.* Reprint from Med. Rev. Bergen: Griegs Boktrykkeri, 1917. Pp. 117.
This is an investigation of the height of Norwegian children from city and country schools, both elementary and higher classes. The writer gives growth curves and increments which he considers normal for Norwegian children. An excellent list of works in the Scandinavian countries is appended.

705. SCHIÖTZ, C. (Measurements and Tables for Determining the Physical Development of Norwegian School Children). *Tidsskr. f. d. norske Taegefor.*, 1918, (38), 490-498.

706. SCHIÖTZ, C. Aldrene 12 til 17 aar. *Med. Rev.*, Apr. 1919.
This article deals with measurements of 231 boys and 177 girls, ages 12 to 17 years, measured under the auspices of the Anthropological Institute of the University of Kristiania. The children came from the families of skilled laborers and trades people. A special study was made of the signs of pubescence. Body volume was calculated for different ages by Rohrer's formula for the "index der Körperfülle." The article includes a discussion of the statistical methods applicable in the field of physical measurements.

707. SCHIÖTZ, C. Kan Skolehygiejnen blive en betydningsfuld Faktor for Befolkningens Helbredstilstand? *Referat af det hygiejniske Möde i Kobenhavn,* Sep. 2-5, 1919, 56-73. Reprint from *Maanedsskrift for Sundhedspleje.*
This is a critical exposition of methods now in use for evaluating physical development. Schiötz refers to the measurements on 33,000 school children now being made under his direction in Kristiania. He stresses the importance of the weight-height index as a criterion of development.

708. SCHIÖTZ, C. Om veining of malling av skolebarn. *Med. Rev.*, Nov.-Dec. 1919, 551-561.
This is a reply to Hansen's criticism of the use of Rohrer's formula. Schiötz thinks that the Rohrer "index der Körperfülle" is far better than Pignet's index which Hansen approves.

709. SCHIÖTZ, C. Utviklingsforhold hos barn i 2 til 6 aars alder. *Norsk. Mag. f. Laegevidensk.*, 1920, (81), 425-459.
In this article are reported the results of an investigation of 264 boys and 249 girls in orphanages in Kristiania. The writer finds characteristic differences in the development of the sexes at different ages, and differences in the "index der Körperfülle." Comparisons are made with measurements supplied by Törnell (Sweden) and Hertz.

710. VON SCHJERNING,— Sanitätsstatistische Betrachtungen über Volk und Heer. *Bibliothek v. Coler u. Schjerning,* 1910, (28).

711. SCHLAGINHAUFEN, O. *Anthropometrische Untersuchungen an Eingeborener in Deutsch-Neuguinea.* Leipzig: 1914. Pp. 82.

712. SCHLESINGER, E. Der Einfluss der durch die Kriegslage veränderten Ernährung auf die schulpflichtige und die heranwachsende Jugend. *Arch. f. Kinderheilk.*, 1916, (66), 161-179.

Measurements made in 1916 on 1320 boys 6-18 years of age from elementary schools and continuation schools attended by both the lower and the better social classes are compared with measurements on the same classes of children made in 1913 and 1914. Additional measurements on 1050 boys of all social classes for the year 1916 are compared with similar measurements for the years 1906 and 1909. The physical growth of these children was very little influenced by war conditions, though weight and general constitution were slightly affected. Height suffered no stagnation whatever.

713. SCHLESINGER, E. Unterschiede im Wachstum bei Schulkindern und jungen Leuten von verschiedener Konstitution und aus verschiedenen Bevölkerungsschichten. *Dtsch. med. Woch.*, 1917, (43), 1607. Same title, *Strassb. med. Zeitg.*, 1917, (14), 165-168.

714. SCHLESINGER, E. Das Wachstum der Knaben und Jünglinge vom 6 bis 20 Lebensjahr. *Zsch. f. Kinderheilk.*, 1917, (16), 265-304.

Measurements are given for about 10,000 boys from Gymnasien, Realschulen, Oberrealschulen, schools preparatory to these, and from Fortbildungsschulen. The results are treated separately for the well-to-do and the poorer industrial classes. In general the children of well-to-do families were superior in height, weight and chest circumference. Complete distribution tables are given.

*715. SCHLOSS, E. Zur Pathologie des Wachstums im Säuglingsalter. *Jahrb. f. Kinderheilk.*, 1910, (72), 575-598.

A discussion of the concept of growth, according to various investigators and the effect of nutrition, with four curves. No tables.

*716. SCHLOSS, E. *Die Pathologie des Wachstums im Säuglingsalter.* Berlin: Karger, 1911. Pp. 163.

An excellent treatment of growth from the physiological and nutritional points of view. Many graphs, illustrating the pathology of growth.

*717. SCHLOSS, E. *Über Säuglingsernährung.* Berlin: Karger, 1912. Pp. 231.

This contains much experimental material with weight curves on infants, in health and disease, showing the effect of various diets, summer heat, etc.

*718. SCHMID-MONNARD, K. Über den Einfluss des Militärdienstes der Väter auf die körperliche Entwicklung ihrer Nachkommenschaft. *Jahrb. f. Kinderheilk.*, 1892, (33), 327-350.

About 2700 children, mostly from Frankfurt on Main, ages birth to 30 months, were measured. Schmid-Monnard believes his curves can be taken as norms for German children from the families of workingmen. No great difference was found between the children of those who had been judged fit for military service and those who had not served.

719. SCHMID-MONNARD, K. Über den Einfluss der Jahreszeit und der Schule auf das Wachstum der Kinder. *Jahrb. f. Kinderheilk.*, 1895, (40), 84-107.

Malling-Hansen's "periods of growth" are found to hold true of German children as a result of the measurement of 190 children (2-13 years of age) in Halle, throughout a year at intervals of three to six weeks.

720. SCHMID-MONNARD, K. Gewichts- und Längenzunahme bei Kindern. *Zsch. f. Schulgesundheitspf.*, 1896, (9), 317-323.
A reply to criticisms of "Über den Einfluss der Jahreszeit und der Schule auf das Wachstum der Kinder."

721. SCHMID-MONNARD, K. Die chronische Kränklichkeit in unseren Mittleren und Höheren Schulen. XII Int. Med. Cong. zu Moskau, 1897. *Zsch. f. Schulgesundheitspf.*, 1897, (11), 593-620; (12), 666-685.
In an investigation made in Halle on 5100 boys and 3200 girls in the high and middle schools, the writer studied the chronic diseases, fatigue, etc., in respect to effects, and growth in height and weight in individual children through the 14th year.

722. SCHMID-MONNARD, K. Über den Werth von Körpermaassen zur Beurtheilung des Körperzustands von Kindern. *Korrespondenzbl. f. Anthropol.*, 1900, (31), 130-133.
This article reports measurements for 1021 boys and 1071 girls from birth to 14 years. A comparison of the weight of individual children with the average for children of that particular height shows that weight may vary 10 to 20 per cent from that given in the table and development still be normal.

723. SCHMID-MONNARD, K. Über den Werth von Körpermassen zur Beurteilung des Körperzustandes bei Kindern. *Jahrb. f. Kinderheilk.*, 1901, (53), 50-58.
This article emphasizes the necessity for norms for each nationality, locality, etc. Measurements are reported for Halle children as follows: 2000 pre-school children; 500 Volksschüler, 6-7 years; 1700 Mittelschüler, 6-15 years; 1000 Ferienkolonisten, 8-14 years—boys and girls in equal numbers. The average height of heels and weight of clothing is reported for correcting the norms. The development curves have much the same shape as those of Axel Key, Kotelmann, Schmidt, Hasse, and Daffner. Children of the better classes were found to be of superior development.

724. SCHMIDT, E. Die Körpergrösse und das Gewicht der Schulkinder des Kreises Saalfeld. *Arch. f. Anthropol.*, 1892, (21), 385-434.
A comparative study of the growth of boys and girls between the ages of six and 13 in different localities in Germany.

725. SCHMIDT, F. A. AND LESSENICH, H. H. Über die Beziehung zwischen körperlicher Entwicklung und Schulerfolg. *Zsch. f. Schulgesundheitpf.*, 1903, (16), 1-7.
The writers measured 4260 girls of the city of Bonn. Data are given in four tables showing the average weight and height of pupils in each of seven school grades at each year from 5-15 (not measurements of the same individual). The results confirm those of Grazianoff, Sack, Porter, and others, who found that better pedagogical attainments went hand in hand with better physical development. See also SCHMIDT, F. A., *Leibesübungen und Geistesbildung*. Göttlingen: Bandenhoeck u. Ruprecht, 1920. Pp. 39.

*726. SCHRENK,— *Studien über Schwangerschaft, Geburt und Wochenbett bei der Esthin.* Diss. Dorpat: 1880, 361.
Reports length of 300 cases.

*727. SCHRODER,— (Birth Measurements of Infants) *Lehrbuch d. Geburtshilfe*, 1886, 9th ed. 60.

728. SCHULTZ, G. Bericht über die Messungen an Individuen von verschiedenen Nationen. *Acad. imper. d. sci. de St. Petersburg.* (Bull. d. I. classe physico-mathematique), 1845, (4), 226-230.
A comparative study of 63 Russians, Jews and negroes.

*729. SCHULZ,— *Über die Gewichtsverhältnisse der Säuglinge am 10 Lebenstage gegenüber dem Gewichte bei der Geburt.* Diss. Greifswald: 1903.

730. SCHUSTER, E. First Results from the Oxford Anthropometric Laboratory. *Biometrika,* 1911-12, (8), 40-51.

This consists of three tables giving head measurements with their means, standard deviations and correlation coefficients.

*731. SCHUTE,— Natürliche Ernährung und Gewichtsverhältnisse von 100 Säuglingen der Osnabrücker Hebammenlehranstalt. *Dtsch. med. Woch.,* 1915, (41), 618-620.

This gives a combined weight curve of 56 boys and 44 girls from birth to 18 days. The same children were not followed consecutively. There is one graph, not very clearly explained, however.

*732. SCHÜTZ,— (Birth measurements of Infants of Leipzig). *Beiträge z. Geburtsh., Gynäk., u. Pädiat.* (Festgabe f. Crede's Jubileum, 1881.

733. SCHUYTEN, M. C. *Stad Antwerpen, Paedologisch Jaarboek,* 1902-1903. Leipzig: F. Brandstetter.

734. SCHUYTEN, M. C. De voedings coefficient van de Antwerpsche Scholieren. *Nederl. Tijdschr. v. Geneesk.,* 1919, (1), 457.

735. SCHWARZ, E. *Anthropology* (Novara Expedition). A System of Anthropometrical Investigations as a Means for the Differential Diagnosis of Human Races. Vienna: 1862. Pp. 24.

736. SCHWERZ, F. Untersuchungen über das Wachstum des Menschen. *Arch. f. Anthropol.,* 1911, n. F. (10), 1-38.

737. SCHWERZ, F. *Über das Wachstum des Menschen.* Bern: Drechsel, 1912. Pp. 28.

738. SCHWIENING, H. Beiträge zur Rekrutierungsstatistik. *Klin. Jahrb.,* 1908, (18).

739. SCHWIENING, H. Über die Körperbeschaffenheit der zum Einjährigen freiwilligen Dienst berechtigten Wehrflichtigen Deutschlands. *Veröffentl. a. d. Geb. d. Militär-Sanitätswesens,* 1909, H. 40.

This introduces Pignet's formula in Germany, and uses it on 52,066 young men. The formula is not found to be of much help in judging the individual but is useful for comparative measures of large groups.

740. SCHWIENING, H. Körpergrösse und Körpergewicht des Menschen. *Dtsch. med. Woch.,* 1914, (40), 498-500; 556-558.

Measurements of 113,000 German recruits 20 to 22 years old with respect to weight and height. The data are analyzed in 6 tables and 1 graph dealing with occupation, geographical distribution, etc. Comparisons are made with the data of Hassing, and the work of Gaertner is discussed.

741. SEAVER, J. W. *Anthropometric Tables Arranged from the Measures of 2300 Students.* New Haven: 1889.

A table giving percentile values for 50 different measurements with ages ranging between 16 and 21 years.

742. SEAVER, J. W. Some New Anthropometrical Data. *Yale Med. J.,* 1895-96, (2), 149.

743. SEAVER, J. W. *Anthropometry and Physical Examination, for Practical Use in Connection with Gymnasium Work and Physical Education.* Meriden, Conn.: Curtis-Way Co., 1909. Pp. 191.

This is an important contribution to the general subject of anthropometry and contains 15 chapters on various anthropometric subjects. Chapters VII, VIII and IX, on graphic

anthropometry, the law of growth and percentile methods of tabulation, are particularly good. A number of important charts and tables are included.

744. SEGGEL,— Über das Verhältnis von Schädel und Gehirnentwicklung zum Längenwachstum des Körpers. *Arch. f. Anthropol.*, 1903, n. F., (1).
Tables of growth are constructed from over 3000 measurements.

745. SEGGEL,— Verhältnis von Schädel und Gehirnentwicklung zum Längenwachstum des Körpers. *Arch. f. Anthropol.*, 1904, (29), 1.
Tables constructed from 3068 measurements on 700 Gymnasium pupils of München.

746. SEILER, B. W. *Naturlehre des Menschen mit Bemerkungen aus der vergleichenden Anatomie für Künstler und Kunstfreunde.* Leipzig: Arnoldische Buchhandlung, 1826.

747. SELIGMAN, C. G. The Physical Characters of the Arabs. *J. Roy. Anthropol. Inst. Gr. Brit. and Irel.*, 1917, (47), 214-237.

748. SERGI, G. An Anthropological Cabinet for Pedagogic Purposes. *Educ.*, 1886, (7), 42-49.
In his discussion on the formation of an anthropological cabinet Sergi files a detailed biographical chart, including both physical and mental observations, together with remedial agencies and educational measures.

749. SEYFFARTH,— Beitrag zur Verwertbarkeit des Pignet'schen Verfahrens. *Dtsch. militärärzl. Zsch.*, 1911.
The writer has tried out Pignet's formula on recruits, and agrees in the main with Ott.

*750. SFAMENI,— (Birth Measurements of Infants). *Annali di obstetricia e ginecologia*, 1901, No. 9.
Reports the measurements of 126 boys and 126 girls.

751. SHORTT, J. Notes on Differences in Weight and Stature of Europeans and Some Natives of India. *Trans. Ethnol. Soc.*, London: 1863, N. S., (2), 213-216.
This includes six tables of average measurements with 20 to 60 subjects.

752. SHUTTLEWORTH, G. E. The Health and Development of Idiots Compared with Mentally Sound Children of the Same Age. *Proc. Assoc. of Med. Off. of Amer. Inst. for Idiotic and Feeble-minded Persons*, 1876-86, 315-322. Also published by J. B. Lippincott, Philadelphia, 1877. (See also Tarbell, G. G.)
A very good paper on the growth and mortality of mentally deficient children, with valuable tables and height and weight curves.

753. SICHOFF,— *(Measurement of Volume and Surface of the Body of Children.)* Diss. Petrograd: 1902.

*754 v. SIEBOLD, E. Über die Gewichts und Längenverhältnisse der neugeborenen Kinder, über die Verminderung ihres Gewichts in den ersten Tagen und die Zunahme desselben in den ersten Wochen nach der Geburt. *Monatsch. f. Geburtsk.*, 1860, (15), 337-354.
This is an interesting article historically. It contains the birth weight and length of 3000 children.

755. SIEGMUND-SCHULTZE, F. Die Wirkung der englischen Hungerblockade auf die deutschen Kinder. Sonderabdruck aus *Die Eiche*, Berlin: Zillesen, 1919. Pp. 32.
This pamphlet contains statements regarding the effect of food shortage on public health in general. Both adults and children are said to have suffered shockingly in weight. A table for

21 children weighed Jan. 1, 1916, Jan. and June, 1917, Jan. and June, 1918, Jan. 1919, reveals far less than the normal increase in weight. As the ages of the children are not given, the table is of little statistical value.

*756. SIESEL, P. *Über wiederholte Geburten derselben Frau in Bezug auf Gewichts- und Längenverhältnisse des Kindes.* Diss. Strassburg: 1905.

*757. TEN SIETHOFF, E. G. A. Over de voeding van det Kind in het eerste levensjaar in het bizzonder over de voeding met onze Kindermelk. *Nederl. Tijdschr. v. Geneesk.*, 1899, 2 R., (35), d. 1, 305-321.

*758. SIEVEKING, C. H. Gewichtstabellen von Brustkindern und künstlich ernährten Säuglingen der Hamburger Fürsorgestellen 1913. *Zsch. f. Säuglingsfürsorge*, 1914-15, (8), 154-159.

759. SILBERMANN, J. T. Proportions physiques ou naturelles du corps humain exprimées en mesures métriques et rapportées à la taille de 1.60 m. *Compt. rend. acad. d. sci. de Paris*, 1856, (42), 454-456; 495-497; (43), 1156-1157.
A study of 511 men from 156 mm. to 184 mm.

760. SIMON, G. Untersuchungen an wehrpflichtigen jungen Badnern nach dem Pignet'schen Verfahren. *Arch. f. soz. Hyg.*, 1912, (7), 138.
Pignet's formula was found useful for a general survey of the physical strength and development of recruits, for comparing recruits from different districts and different vocation groups, and for comparing recruits within a vocation.

761. SIMON, T. Recherches anthropométriques sur 223 garcons anormaux âgés de 8-23 ans. *Année psychol.*, 1899, (6), 191-247.
A very careful study of 223 boys, with measurements and a résumé of the work done by others, including comparative tables.

762. SIMON, T. Recherches céphalométriques sur les enfants arriérés de la colonie de Vaucluse. *Année psychol.*, 1900, (7), 430-489.
Head measurements are reported for 100 feeble-minded children of all degrees of mental defect.

763. SKIBINSKI,— *Das Körpergewicht von Münchner Schulkindern.* Diss. München: Müller & Steinicke, 1914.

764. SMEDLEY, F. W. *Rep. Dep. Child-Study and Pedag. Investig., Chicago Pub. Schools.* Chicago: 1900, (2), 10-48.
This report is the continuation of the work started by W. S. Christopher. It contains tables and charts of norms resulting from the measurement of height, weight, vital capacity, grip, and the use of the ergograph with Chicago public school children, and a discussion of the correlation between these results and school standing.

765. SOGRAF, N. J. Anthropometrical Researches in the Provinces of Jaroslav, Kostroma, and Vladimir. *8th Cong. of Russian Naturalists and Physicians.* St. Petersburg: 1890.

766. SOLHAUG, L. S. A Comparative Anthropometric Study. *U. S. Nav. Med. Bull. Washington*: 1920, (14) 1-8, 4ch.

*767. SPIEGELBERG,— (Birth Measurements of Infants) WIENER: *Lehrb. d. Geburtsh.* 1882-84.
Reports the weight of infants in Breslau.

768. SPIELREIN, I. Über Kindermessungen in Rostow am Don. *Zsch. f. Schulgesundheitspf.*, 1916, (29), 451-461; 503-513; 548-560.
In the spring of 1913, 2000 South Russian boys and girls, aged 6-15 years, were measured to determine the effect of schools on physical development. Height, weight, chest circumference and dynamometer performance were recorded. Spielrein

agrees with other authorities who find that school stimulates physical development. Racial comparisons and classification of children according to occupation of parents, house rent, various physical indices, etc. are included. A positive correlation was found between physique and intelligence, that is, boys with larger chest circumference reached the higher school grades.

769. SPIER, L. The Growth of Boys: Dentition and Stature. *Amer. Anthropol.*, 1918, (20), 37-48.

770. SPITZER, O. Untersuchungen an Krakauer Mädchen. *Mitt. d. anthropol. Gesellsch. in Wien*, 1915, (45), 210-215.
A study of the head and body measurements of 1000 Polish girls, ages six to 15 years. Thirteen tables are included.

771. SPITZY, H. *Die körperliche Erziehung des Kindes*. Berlin and Wien: Urban und Schwarzenberg, 1914. Pp. 424.
This is principally concerned with physical training, but contains a chapter on embryological and one on later development.

772. SPRINGER,— *Etude sur la croissance et son rôle en pathologie.* Paris: 1890.

773. STANWAY, S. Results of Investigations Made into the Comparative Condition of Factory and Non-Factory Children in Manchester and Stockport. (Report of the Factory Commission) London: *Parliam. Rep.*, 1833, (20), DI, 87.
This is the report of the commission of which Cowell was chairman. It was found from an investigation of 1062 factory and 288 more favored children that the latter were better developed physically.

774. STARKOW,— *(The Physical Development of the Pupils of Military Schools).* St. Petersburg: 1897.
Russian, cited by Wiazemsky.

775. STEET, G. C. Development and Growth of Boys between 13 and 20 Years of Age. *St. George's Hosp. Rep.* London: 1874-76.

776. STEINHAUS,— Proceedings of the 13th Annual Congress of the German Society for School Hygiene and the 5th Annual Congress of German School-physicians. *Zsch. f. Schulgesundheitsp.*, Beiheft, 1913.
Norms for German children who have completed their sixth year are given for height, weight, chest circumference and skull circumference, with the recommendation that children should not in general be admitted to school before this age or before these minimum physical requirements are met.

777. STEPHENSON, W. On the Rate of Growth in Children. *Trans. 9th Intern. Med. Cong.* Washington: 1887, (3), 446-452.

778. STEPHENSON, W. On the Relation of Weight to Height and the Rate of Growth in Man. *Lancet-Clinic*, 1888, (2), 560-564.
In this report Stephenson gives four tables and two charts, and maintains that had we the means of scientifically comparing the relation of weight to height and of drawing conclusions therefrom, such data would be as frequently supplied as is now the daily temperature. The first table checks up the height and weight in inches with yearly increments for boys and girls between the ages of five and 18. The height and weight indices are also given, and a comparison between the height and weight coefficients of laboring and nonlaboring classes.

779. STERNBERG, G. Physique of Accepted Recruits and Reenlisted Men of United States Army. *Rep. Surg. Gen. U. S. A., to Sec'y of War.*, Washington: 1893, (20), 226-227.

780. STEWART, S. F. A Study of Physical Growth and School Standing of Boys. *J. of Educ. Psychol.*, 1916, (7), 414-426.

This deals with the weight and height of 207 boys in the elementary and high school of the University of Chicago. The chief conclusion, supported by 13 charts, is that "when we consider averages of groups of the same age the group one year ahead of the normal grade averages both heavier and taller than the group of the normal age."

781. STIEDA, L. Über die Anwendung der Wahrscheinlichkeitsrechnung in der anthropologischen Statistik. *Arch. f. Anthropol.*, 1882-83, (14), 167-182.
An extensive theoretical discussion of measurements, with graphs.

782. STILES, C. W. AND WHEELER, G. A. Heights and Weights of Children. *U. S. Pub. Health Reports*, 1915, (30), Part 2, 2990-3003.
This is a study of white children in a southern U. S. city. Measurements for 771 boys and 881 girls are reported in two groups; first from homes of good sanitary condition; second, from homes of poor sanitary condition. The superiority of the children from homes of good sanitary condition is shown by the fact that in 24 total year groups (12 for boys, 12 for girls, ages six to 17) the children from better homes excelled in height in 16 periods, those from poorer homes only in eight periods. With respect to weight, children from superior homes excelled in 15 periods, those from inferior homes in nine periods.

*783. STOCKTON-HOUGH, J. Statistics Relating to Seven Hundred Births (White) Occurring in the Philadelphia Hospital from 1865-72. *Philad. Med. Times*, 1885-86, (16), 92-94.
A table is given showing the effect of the age of the mother and of the number of previous pregnancies on the length and weight of the offspring. Another table shows the relation between the entire length and the length of the trunk of the new born child. Female children are found to be lighter at birth and to have a greater proportional length of trunk.

*784. STOLL,— *Über Gewichtsveränderungen Neugeborener.* Diss., 1876.

*785. STOLTE, K. Über Störungen des Längenwachstums der Säuglinge. *Jahrb. f. Kinderheilk.*, 1913, (78), 399-425.
An excellent discussion of growth problems and literature including the purely physiological work. Two normal height curves are given with data on diet, etc., also curves for 17 children who were suffering from various nutritional disturbances and whose curves show a considerable effect upon growth.

786. STORY, W. W. *The Proportions of the Human Figure, According to a New Canon for Practical Use, with a Critical Notice of the Canon of Polycletus, and of the Principal Ancient and Modern Systems.* London: 1866. Pp. 63.
A detailed study of parts of the body, with many allusions to the work of classical artists.

787. STRATZ, C. H. Über die Körperformen der eingeborenen Frauen auf Java. *Arch. f. Anthropol.*, 1898, (25), 233-242.

788. STRATZ, C. H. Das normale Wachstum. *Vierteljahrssch. f. körperl. Erziehung*, 1908, (4), 135.

789. STRATZ, C. H. Wachstum und Proportionen des Menschen vor und nach der Geburt. *Arch. f. Anthropol.*, 1909, (8), 287-297.
A good article discussing growth before and after birth and giving many drawings and graphs.

790. STRATZ, C. H. Über die Normalgestalt des Menschen. *Arch. f. Anthropol.*, 1911, n. F., (11), 43-49.

791. STRATZ, C. H. Grösse und Proportionen der menschlichen Rassen. *Arch. f. Anthropol.*, 1911, n. F., (10), 226-232.

792. STRATZ, C. H. Het normale Gewicht van Kindern. *Nederl. Maandschr. v. verlosk. en vroumenz en v. Kindergeveesk.*, 1912, (1), 376-380.

793. STRATZ, C. H. Gestalt und Wachstum des Kindes. In KRUSE & SELTER: *Die Gesundheitspflege des Kindes.* Stuttgart: Enke, 1914, 7-28.
A general account of growth with references and comparative tables of results from different investigators and graphic representations of changes in body proportions.

794. STRATZ, C. H. Betrachtungen über das Wachstum des Menschen. *Arch. f. Anthropol.*, 1915, n. F., (14), 81-88.
This contains one table and much bibliographical material.

795. STRONG, E. K. *Effects of Hookworm Disease on the Mental and Physical Development of Children.* (Inter. Health Comm. Public. No. 3.) New York: Rockefeller Foundation, 1916.
Data are given for 115 children, some normal and some in various stages of recovery from the disease. Height and weight are somewhat affected but not so much as one would expect from the nature of the disease.

796. SULIGOWSKI, F. Kilka slów o pomiarach antropomentrycznych mlodziezy gimnazyum mezkiego w Radomin. *Medyeyna*, Warszawa: 1887, (15), 512, 544, 558-559, 641.
The anthropometric measurements of pupils in the gymnasium of Radom. This investigation deals primarily with statistics in height and weight, together with other measurements and personal characteristics of 1783 males between the ages of nine and 21.

797. SÜNDELL,— Mätningar a Stockholms folkskolebarn. *Hygienisk Tidsskrift*, 1917.

798. SZEPESSI, S. (Some Body Dimensions of the Magyar Race) *Honvédorvos*, 1897, (10), 9.
Russian.

799. TALBOT, P. A. Notes on the Anthropometry of Some Central Sudan Tribes. *J. Roy. Anthropol. Inst. Gr. Brit. & Irel.*, 1916, (46), 173-183.
This includes tables giving the individual measurements of 123 subjects and also tables of average measurements.

800. TALLANT, A. W. A Medical Study of Delinquent Girls. *Bull. Amer. Acad. of Med.*, 1912, (13), 283-293.
A study of the physical development of the delinquent girls at Sleighton Farms, Pennsylvania. These girls are about normal in height and weight when compared with Bowditch's norms, but have many sense defects, while 20-25 per cent have venereal diseases.

801. TARBELL, G. G. On the Height, Weight and Relative Rate of Growth of Normal and Feeble-minded Children. *Proc. Ass'n. Med. Off. of the Amer. Inst. for Idiotic and Feeble-minded Persons*, 1876-86, 188-189.
A short paper with height and weight curves.

802. TARBELL, G. G. *Proc. Ass'n. Med. Off. of the Amer. Inst. for Idiotic and Feeble-minded Persons*, 1888-89.
A pioneer study on the growth of feebleminded, the value of which is chiefly in its suggestive material, since few children are included and no statistics are given, although curves of growth are included.

803. TAYLOR, J. J. Anthropometric Notes on the Inhabitants of Checkheaton, Yorkshire. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (67), 507-510.

A comparative study of 20 men, varying from 20 to 60 years of age and from 156.3 to 183.6 cm. in height, and 11 women from 20 to 25 years of age ranging from 146.4 to 163.7 cm. in height.

804. TAYLOR, J. M. The Influence of Bodily Exercise upon Length of Life. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1897, (7), 61-74.
Contains a number of individual measurements, together with a detailed sketch of the athletic life of William B. Curtis, and concludes that the harmful effects of violent athletic competitions are popularly overrated.

*805. TAYLOR, R. The Proportionate Measurements of 250 Full Term New-born Infants. *Amer. J. of Physiol.*, 1918, (45), 569.

*806. TAYLOR, R. Measurements of 250 Full Term New-Born Infants. *Amer. J. Dis. Child.*, 1919, (17), 353-362.
This reports the measurements (16 items), together with correlations and compares the results with those of previous investigators.

807. TERMAN, L. M. *The Hygiene of the School Child.* New York: Houghton Mifflin Co., 1914. Pp. 417.
Contains chapters on the general laws of growth.

808. TEUMIN, S. Topographisch-anthropologische Untersuchungen über die Proportionsverhältnisse des weiblichen Körpers. *Arch. f. Anthropol.*, 1902, (27), 379-432.
A study of 100 subjects, with tables of absolute and relative measurements.

809. TEZYAKOFF, N. (Physical Development of the Public School Pupils of Yelisavetgrad County). *Vestnik obsh. hig. sudeb. i. prakt. med.*, 1896, (29), 2 sect., 121-138.
Russian.

810. THIELE,— (Influence of Disease, especially Tuberculosis, on the Growth and Nutrition of School Children.) *Berl. klin. Woch.*, 1915, (52), 949-950.
Averages obtained by taking the height and weight of 1000 healthy children of Chemnitz for the first and eighth school year, compared with averages for anaemic and tuberculous children, showed that anaemia did not have much effect upon development, but tuberculosis hindered normal growth.

811. THIELE,— Der Einfluss der kreigsmässig veränderten Ernährung auf unsere heranwachsende Jugend. *Berl. klin. Woch.*, 1916, (53), 780-781.
This is a comparison of the measurements of 14 year old children of Chemnitz before the beginning of the war with measurements of a similar age group in 1916. No harmful effect on physical development was apparent although too few cases were measured to furnish reliable comparisons.

812. THOMA, R. *Untersuchungen über die Grösse und das Gewicht der anatomischen Bestandtheile des menschlichen Körpers.* 1882.

813. THOMA, R. *Weiteres über die Grösse und das Gewicht.* Leipzig: 1882.

814. THOMA, R. Untersuchungen über das Schädelwachstum und seine Storungen. *Virchow's Archiv. f. path. Anat.*, 1918, (205), 97-114.

815. THOMAS, C. J. (Physical Development of Young Children in Southwark) *Rep. of Med. Off. L. C. C.* (Ed.), 1905, 7-11.
Cited by Kerr.

816. THOMSON, A. S. Observations on the Stature, Bodily Weight, Magnitude of Chest, and Physical Strength of the New Zealand Race of Men. *J. of the Geog. Soc.*, 1853, (23), 87.

817. THORNDIKE, E. L. Physical Growth of Children. In *Notes on Child Study* (Columbia Univ. Contrib. to Philos., Psychol. and Educ.) New York: 1901, 21-30.
A very suggestive and valuable chapter, which serves to answer the question "At what rate do children grow and what are the sizes they reach year after year?" Boas' averages and mean variations are included and distribution figures for different ages, also a series of yearly increments of growth in stature for boys and girls.

818. THORNDIKE, E. L. *An Introduction to the Theory of Mental and Social Measurements.* New York: Science Press, 1904. Pp. 212.
An excellent book on how to handle mental, social and physical measurements. Chapter XII treats of the sources of error in measurements and Chapter XIII gives conclusions and further references.

819. THORNE, L. S. The Physical Development of the London Schoolboy; 1890 examinations. *Brit. Med. J.*, 1904, Part 1, 829-831.
These are measurements of scholarship boys. (For girls see Berry). The height and weight of boys nine to 16 years are reported in a table.

820. TICHANOFF, M. T. *(Energy of Growth at the Extremities and Vertebral Column at 14 Years of Age.)* St. Petersburg: Mendeleviteb, 1894.

821. TITCHENER, E. B. Anthropometry and Experimental Psychology. *Philos. Rev.*, 1893, (2), 187-192.
A discussion of the relation between the anthropometric laboratory and psychological laboratory. The main difference between the two laboratories is one of aim and practice on the part of those who are being trained. Training in the former depends less on practice and more on instruction than in the latter.

822. TOPINARD, P. *L'anthropologie.* Paris: 1895. (Bibliotheque des sciences contemporaines.)
A general treatment of anthropology with exceptionally strong chapters on craniometry and short chapters on physical characteristics and growth.

823. TÖRNELL,— En Svensk Folkskola pa Landet. *Hygiea*, 1909, 911.

*824. TOWNSEND, C. W. The So-Called Physiological Loss in Infants. *Boston Med. & Surg. J.*, 1887, (116), 157-160.
An analysis of the cause of the loss in weight with report on previous work and tables showing the average losses and gains of a number of hospital infants.

825. TUCKERMANN, F. *Anthropometric Data Based Upon Nearly 3000 Measurements Taken From Students.* Amherst: 1888.

826. TUXFORD, A. W. A Measure of Physical Development in School Children. *Sch. Hygiene*, 1917, (8), 656-659.
The author compares the relation between the stages of development reached by a child or group of children and the normal stage for the same age or ages.

827. TUXFORD, A. W. AND GLEGG, A. R. The Average Height and Weight of English School Children. *Brit. Med. J.*, 1911, (1), 1423-1424.
The average height and weight of 583,640 children aged three to 14 years, is reported. These measurements made in 1909 and 1910 by school medical officers are analyzed in two tables and one graph, comparisons being made between city and country children and between children for the North and those from the South of England.

828. Tyler, J. M. Growth in Weight and Height. In *Growth and Education.* Boston: Houghton Mifflin Co., 1907, 263-270.

One chapter from a good book on growth and an appendix which gives a series of compound tables for weight, height and other measurements. References are appended.

829. Tyler, J. M. The Study of Growth in Children. *J. of the Nat. Educ. Ass'n. of the U. S.*, 1908, 913-916. Also *J. of Educ.*, 1908, (68), 113-114.

A good general discussion without measurements.

*830. Uffelmann,— *Handb. d. Hyg. des Kindes*, 1881.

Deals with the growth of infants.

831. Urick, A. L. *Rep. Bur. of Labor Statis.*, Des Moines, Iowa: 1918, 104-117.

A report on height and weight of Iowa children between 14 and 16, receiving working permits, comparing rural and urban children.

832. Vahl, M. Mitteilungen über das Gewicht nichterwachsener Mädchen. *Cong. period. internat. sci. med.*, Copenhagen: 1884, 120-125.

The girls of this school ranging from four to 16 years, were weighed semi-annually from 1874 to 1883, and the resulting increments and percents of gain show that there is a greater increase in growth in weight in summer than in winter.

833. Vaney, V. Relation entre le développement physique et le développement intellectual. *Bull. de la soc. libre pour l'étude de 'lenfant*, 1906, (6), 195-202.

834. Vaney, V. Le développement physique des arriérés d'école. *Bull. de la soc. libre pour l'étude psychol. de l' enf.*, 1907-08, (8), 108-114; 1909, (9), 26-29.

*835. Variot, G. *Clinique infantile*, 1907-08, 15 Dez., (5), 1.

Deals with the effect on height of pathological nutrition conditions.

*836. Variot, G. L'accroissement statural et l'accroissement pondéral chez le nouveau-né. *Presse méd. belge*, 1908, (60), 821-826. Practically the same material as published in *Ann. de méd. et chir. inf.*, 1908, (12), 447-452.

Variot (*Clinique infantile*, Dec. 15, 1908) presented a case of an infant with hypertrophy in which increase of height was less affected than increase of weight. He called this "dissociation of growth." In this article Variot shows that dissociation of growth also takes place in normal cases during the first months of life. He finds from several observations of height that infants have grown considerably within a few days after birth but have lost weight or simply reattained the birth weight. He gives four individual cases of several months' duration where height increased while weight did not.

837. Variot, G. Note sur la dissociation de la croissance chez les débiles. *Bull. soc. pediatrie*, 1908, (10), 193-195.

Two kinds of "dissociation of growth" are analyzed. In both the weight does not increase in the same proportion as does height and both conditions are abnormal.

838. Variot, G. and Chaumet,— Tables de croissance dressées en 1905 d'après les mensurations de 4400 enfants parisiens de 1-15 ans. *Compt. rend. d. acad. de sci. de Paris*, 1906, (142), 299-301. Also in *Bull. soc. de pédiat. de Paris*, 1906, (8), 49-58. Also *Bull. a occul. Toulouse*, 1906, 3 S., (20), 46-52.

These measurements were made on children from crèches, dispensaries, écoles maternelles, écoles communales, orphan asyl-

ums and vocational schools. A table is given for comparison with the results of Rotch and Quetelet, together with a curve representing the growth of boys and girls in weight and height.

839. Variot, G. and Chaumet,— Tables de croissance des enfants parisiens de 1 à 16 ans. *Bull. et mém. de soc. d'anthropol. de Paris*, 1906, (7), 51-65.

*840. Variot, G. and Fliniaux,— Tables des croissances comparées des nourrissons élevés au sein et au biberon durant la première année de la vie. *Compt. rend. acad. d. sci. de Paris*, 1914, (158), 1361-1364.

This article reports with tables the average height and weight of infants 1-12 months of age. For each month there were 25 boys and 28 girls who were breast fed, 20 boys and 20 girls on mixed feeding and 41 boys and 32 girls who were artificially fed. Contrary to the usual findings, only a small difference was found between the breast fed and the artificially fed.

841. Vassiliev,— (Materials for the Study of the Physical Development of Girls.) *Zdorovie*, 1881, (8), No. 1.

Russian, cited by Wiazemsky.

*842. Veit, G.— (Birth Measurements of Rostock Infants). *Monatsch. f. Geburtsk. u. Frauenkrankh.*, 1855, (6), 141.

843. Verneau, R. Résultats anthropologiques de la mission de M. de Gironcourt en Afrique occidentale. *L'anthropologie*, 1916, (27), 47-95; 211-242; 407-430; 539-568.

A few tables of measurements on a small number of subjects.

844. Vierordt, K. Wachstum. Gerhard: *Handbuch der Kinderkrankheiten.* Tübingen: 1877, (1), 59-91.

This is an important early treatise on the growth of the body and its parts, with copies of tables from previous investigators and references.

845. Vierordt, K. Physiologie des Kindesalters. Gerhard: *Handbuch der Kinderkrankheiten.* Tübingen: Laupp, 1881, 219-291.

This is a general treatise on growth. It deals briefly with the diurnal variations in weight, with birth weight, with the curve of growth, with the factors that influence growth, and with the growth of the different parts of the body.

846. Vierordt, K. *Anatomische, physiologische und physikalische Daten und Tabellen.* 3d Edition. Jena: Fischer, 1906. Pp. 622.

Contains comprehensive data and tables on the anatomical, physiological and psycho-physical phases of development, with historical material bearing directly on the problem of growth of infants, children and adults, together with numerous references.

847. Villermé, L. Mémoire sur la taille de l'homme en France. *Annal. d'hyg. publ.*, 1829, (1), 351-395.

This is a study of the height of conscripts in the French army, their age upon attaining complete development and the causes of their physical defects. It contains a table of average height and weight for each of the different *arrondissements and departments.*

848. Villermé, L. Note sur la taille moyenne des habitants de Paris et sur les proportions des difformités et infirmités qui les rendent impropres aux services militaires. *Annal. d. sci. natur.* Paris: 1829, (11), 140.

849. Vinogradorsk-Lukersk, L. (Examination of Growth and Weight of School Pupils by Scientific Methods). *Vestnik. obsh. hig. sudeb. i. prakt. med.*, 1894, (21), pt. 2, 67-186.

850. VOIT, C. Über die Periodicität im Gewichte der Kinder. Reprint from *Münch. med. Woch.*, 1886, (33), 129-131.

This is a discussion of Malling-Hansen's work from the point of view of the advisability of weighing children in a local institution.

*851. VOUTE, A. De voeding van den zuigeling. *Med. Weekbl.*, 1895-96, (2), 133; 197; 269; 338.

*852. WAGNER,— *Beobachtungen über Gewicht und Maase der Neugeborenen.* Diss. Königsberg: 1884.

853. WAGNER, W. Entwicklung des Kinderkörpers von der Geburt zum Abschluss des Wachstums. *Hannover Ver. Züchtungsk.*, 1911.

854. WALKER, E. W. A. The Relationship between the Body Weight and the Length of the Body (Stem Length) in Man. *J. of Physiol.*, 1915, (50), 111. *Proc. Roy. Soc.*, 1916, (89), s. B., 157-173. Same title.

A constant relationship was found between body weight and stem length. A table shows the agreement of actual measurements on 201 children with the calculated values.

855. WARNER, F. Report on the Physical and Mental Condition of 50,000 Children Seen in 106 Schools of London. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1890, (2), 1081-1138.

An important report prepared for the British Medical Association and the Charity Organization Society of London, and preliminary to the data included in the author's study of children.

856. WARNER, F. Physical Defects. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (67), 427-439.

Deals principally with physical defects.

*857. WARREN, S. P. The Average Birth Weight of 2000 Confinements in the State of Maine. *Amer. J. Obstet.*, 1917, (76), 932-936.

858. WEISSE, F. S. A Study of Chest and Abdominal Measurements in Relation to Build. *Med. Rec.*, 1912, (82), 1020-1022.

Measurements of 3035 healthy adult males to whom life insurance policies had been issued. Tables of weight for each one inch increase of height between five feet three inches and six feet are given, together with other measurements. Each additional pound in weight at a given height causes a definite change in the other measurements. By using a table one can determine what should be the measurements of any man over 24 years, of any weight, whose height falls within the limits given.

859. WEISSENBERG, S. Die südrussischen Juden. *Arch. f. Anthropol.*, 1895, (23), 347-424.

Many tables of measurements are given for over 1000 subjects, age five to 75 years.

860. WEISSENBERG, S. Anthropometrische Prinzipien und Methoden. *Globus*, 1904, (89), 350.

*861. WEISSENBERG, S. Das neugeborene Kind bei den südrussischen Juden. *Globus*, 1908, (93), 85.

862. WEISSENBERG, S. Das Wachstum der Hüftbreite nach Alter und Geschlecht. *Monatsch. f. Geburtsh. u. Gynäk.*, 1909.

863. WEISSENBERG, S. Die kaukasischen Juden in anthropologischer Beziehung. *Arch. f. Anthropol.*, 1909, (8), 237-245.

864. WEISSENBERG, S. Das Wachstum des Kopfes und des Gesichts. *Jahrb. f. Kinderheilk.*, 1910, (18), 304-317.

Measurements of nine dimensions of the head on the following classes of subjects: new born, five year old, 10 year old, and 15 year old boys (25 of each), 25 10 year old girls, 50 adult women, 100 adult men, all Jewish. Tables of indices and graphs showing relative proportions are included.

865. WEISSENBERG, S. *Das Wachstum des Menschen.* Stuttgart: Strecker und Schröder, 1911. Pp. 220.
This is the most important recent publication on physical growth and contains chapters on foetal growth, the proportions of the bodies of babies, growth during the periods of childhood, the conditions influencing growth, and the laws of growth. Many authorities are quoted, numerous tables are included, and charts show the growth of different parts of the body, together with the relative heights and height increments of Jews, Russians, Englishmen, and Belgians. The author's measurements are taken on South Russian Jews.

866. WEISSENBERG, S. Armenier und Juden. *Arch. f. Anthropol.*, 1914, n. F., (13), 383-387.
This contains three tables of "Körpermerkmale."

867. WEITZEL,— (Measurements of Girls). *13. Jahresbericht der städischen höheren Mädchenschule in Uhm a. D. f. 1890-91.*
Contains measurements of 298 girls.

868. WELKNER, F. *Untersuchungen über Bau und Wachstum des menschlichen Schädels.* Leipzig: Engelmann, 1862.

869. WENGLER, J. Das Volumen und Spezifische Gewicht des menschlichen Körpers. *Pflüger's Arch. f. d. ges. Physiol.*, 1906, (115), 612.

870. WEST, G. M. Worcester School Children; Growth of Head, Body, and Face. *Science*, 1893, (21), 2-4.
This investigation is based on several measurements including the weight and height of 3352 children between the ages of five and 21 in public and private schools of Worcester.

871. WEST, G. M. The Anthropometry of American School Children. *Mem. Intern. Cong. Anthropol.*, 1893, Chicago: 1894, 50-58.

872. WEST, G. M. Anthropometrische Untersuchungen über die Schulkinder in Worcester, Mass. *Arch. f. Anthropol.*, 1894, (22), 13-48.
This is a more detailed and elaborate study of the data included in the previous investigation.

873. WEST, G. M. Observation of the Relation of Physical Development to Intellectual Ability, Made on the School Children of Toronto, Canada. *Science*, N. S., 1896, (4), 156-159.
In this investigation the results are opposed to those of Porter. In place of using school grade as the criterion index of precocity, West uses the teacher's judgment, and appends a number of curves without figures, giving the relative sizes of good and poor students.

874. WHIPPLE, G. M. *Manual of Mental and Physical Tests.* Baltimore: Warwick and York, 1915. Pp. 365 (vol. 1) +336 (vol. 2).
From the standpoint of education this is the most important contribution now accessible on the general subjects of mental and physical tests. Chapter II treats of the general rules for the conduct of tests; Chapter III, the treatment of measures; Chapter IV, physical tests. The averages of Boas, Burk and Smedley are used as norms.

875. WHYTE, G. D. (Physical Measurements of Chinese) *Nat. Med. J., China*, 1917, (3), 101-113.

876. WHYTE, G. D. The Height, Weight and Chest Measurements of Healthy Chinese. *China Med. J.*, 1918, (32), 210-216; 322-328.
This is a report of the research committee of the China Medical Missionary Association, which undertook to establish norms for the Chinese people. Height, weight, circumference of the head and two indices (height-weight and Pignet) are reported on 1741

males from two provinces of South China and 202 females. A curve showing the average height, 10-19 years, of males and females is given and the Chinese children are compared with Scotch boys and girls. This comparison shows the Chinese to be both smaller and lighter.

877. WIAZEMSKY, N. W. *Ismenenia organisma v periode sformirorania.* St. Petersburg: 1902.
Modifications of organisms during the period of puberty from the age of 10 to 20. This is an important study containing 278 tables and 43 diagrams.

878. WIAZEMSKY, N. W. *Influence de différents facteurs sur la croissance du corps humain.* Paris: Maloine, 1907. Pp. 394.
This is an analysis of previous work with additional data on 1808 pupils of a school for boys at St. Petersburg. Chapters are included on height, span of arms, circumference of chest, weight, muscular strength and on the diameters of the head. There are numerous comparative tables and 39 graphs showing the average annual increments in various measurements from 11 to 18 years. The author refers to many Russian works not usually mentioned in the literature of physical development, but the citations are not specific enough to make these studies accessible.

879. WIENER, C. *Über das Wachstum des menschlichen Körpers.* Karlsruhe: 1890. Pp. 23.
A monograph containing curves and tables giving the annual measurements in height, weight and head girth of Wiener's four sons from birth to maturity. A very valuable contribution.

880. WIETLIND,— *Iagttagelsar rörande helsotilstandet i nogra af Göteborgs verkskolor.* Goteborg, Sweden: 1878.

881. WILLIAMS, E. H. Tables Indicating Progressive Increase of Development in Boys Examined for Naval Service and Some Remarks on the Growth of the Human Body. *Statis Rep. Health Brit. Navy,* 1902, 149-172.

*882. WINCKEL,— Untersuchungen über die Gewichtsverhältnisse bei 100 Neugeborenen in den ersten 10 Tagen nach der Geburt. *Monatsch. f. Geburtsk.,* 1862, (19), 416-442.
Contains the results of daily weighing.

883. WISSLER, C. Growth of Boys; Correlations for the Annual Increments. *Amer. Anthropol.,* 1903, N. S., (5), 81-88.
This is a very important contribution to the study of growth based on the correlation of increments of growth in height and weight for 72 boys for the periods from 12 to 17 years of age.
"The real problem in studies of growth is the determination of the annual increments during the period of growth for each degree of adult stature. Until we have sufficient measurements to tell us how the tall men and likewise the short men grow in boyhood, we can form no idea of the significance of any given part of the growing period. Thus far our knowledge of growth, as determined by physical measurements of children, is based on average statures obtained by single measurements of large groups of children. We thus gain a certain general curve of growth from which we infer certain tendencies to periodic growth. In all such measurements we have ample means for determining the variation between individuals at each period of life, but no way of estimating the degree of variation in the same individual from year to year. Thus, while we know that the average maximum increase in the stature of boys occurs about the fourteenth year of life, we have no means of knowing how many boys reach their maximum before or after this point."

No imprints of these tables (a. b. c. d. e.) were made and the data are inaccessible.

884. WITT, J. *De proportiën van het menschelijk ligchaam afgebeeld, met de beschrijving, in het Nederduitsch en Fransch.* Amsterdam.

*885. WITZINGER,— *Über die Stirnfontanelle und den horizontalen Umfang des Kopfes beim Neugeborenen.* Diss. Bern: 1876.
Also reports weight of the new born.

*886. WOLFF, F. *Über die Gewichtsverhältnisse Neugeborener.* Diss. Munchen; 1883.

887. WOOD, E. E. Notes on Oriental Babies. *Amer. Anthropol.*, 1903, N. S., (5), 659-666.
This article mentions the work of other investigators of Oriental races but gives no references. It contains tables with measurements on 61 Chinese and 22 Japanese, aged one day to seven years. The data for each age are too few to furnish reliable norms.

888. WOOD, M. A. *Anthropometric Table Compiled from the Measurements of 1100 Wellesley College Students Arranged According to Bodily Heights.* 1890. (No imprint).

889. WOOD, M. A. *Statistical Tables* (concerning the class of 1891 of Wellesley college, numbering 104 women.) (No imprint).

890. WOOD, M. A. *Statistical Tables* (showing certain measurements of 40 freshmen of Wellesley college at the beginning of November 1891, and the end of May, 1892, after six month of gymnasium training.) 1892. (No imprint).

891. WOOD, M. A. Six Comparative Tables (showing records of class crews receiving training in gymnasium and on the lake; of 20 students receiving training in the gymnasium; and of 20 students receiving no training in the gymnasium.) *Wellesley College, President's Rep.*, Boston: 1893, 35-40.

892. WOOD, M. A. *Anthropometric Table, Arranged After the Method of Percentile Grades, of the Measurements of 1500 Wellesley College Students.* 1903. (No imprint).

893. WOOD, T. D. *Height and Weight Table for Girls and Boys.* New York: New York Child Health Organization, 1918.
A card of norms for weight at years 5-18 arranged to correspond to the appropriate height.

894. WORONICHIN, N. Fortlaufende Wägungen während der Dentition. *Jahrb. f. Kinderheilk.*, 1880-81, (16), 133-143.
This article reports continuous measurements from 6 months up to the age of the breaking through of the last milk tooth. Although only one subject was used, a boy, the data on diet, and language development are very full and make the study one of unusual interest.

895. WRIGHT, E. A. Physical Training of Post-Adolescent Girls. *J. of Nat. Educ. Ass'n. of the U. S.*, 1910, 942-946.
A general discussion on growth and physical training.

896. v. WULLERSTORF-URBAIR, B. *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857-59.* Anthropologischer Theil, 2te Abtheilung. Körpermessungen an individuen verschiedener Menschenrassen vorgenommen durch Dr. Karl Scherzer und Dr. Eduard Schwarz, bearbeitet von Dr. Weisbach. Wein: 1867, (4).

897. WYLIE, A. R. T. Investigation Concerning the Weight and Height of Feeble-Minded Children. *J. of Psycho-Asthen.*, 1899, (4), 47-57. See also, 1900, (5), No. 5; 1902, (7), No. 1.

This investigation is based on 161 boys and girls from Minnesota. The number was later increased to 400.

898. Wylie, A. R. T. Contribution to the Study of the Growth of the Feeble-Minded in Height and Weight. *J. of Psycho-Asthen.*, 1903, (8), 1-7.
A study of the height and weight of feeble-minded children, with the conclusion that feeble-minded children are subnormal in height and weight. The feeble-minded, in height and weight, approximate the normal most closely at 10 years of age. A high mean variation is characteristic of the feeble-minded.

899. Yatsuta, K. Z. (Anthropometric Study of Enlisted Men) *Voyenno med. J.*, 1914, (240), Med.-spec., part, 381-389.
Russian.

900. Young, J. E. Supernormal Environment in its Relation to the Normal Child. *Trans. 4th Int. Cong. on Sch. Hyg.* Buffalo: 1913, (2), 17-30.
Children of the University of Chicago School of Education (404 girls and 201 boys) were examined for this report. Height, weight, vital capacity, blood pressure, and haemoglobin are reported for ages six to 18 and compared with measures of children from other social groups. The children of the rich are found to be taller and heavier and to have greater lung capacity than public school children. The measurements are peculiar in that the pre-pubertal increase in the development of girls over that of boys was not noted.

901. Zacharias, O. Über Periodicität in der Gewichtszunahme bei Kindern. *Monatl. Mitt. a. d. gesamtgeb. d. Naturw.* Berlin: 1889, 35-37; 57-60.
A general discussion with particular reference to the work of Malling-Hansen.

902. Zahor, J. W. Z. *(Report on the Investigation of Certain Physical Conditions of School Children of Prague, Including Stature, Weight, Eye Defects, and Spinal Curvature.)* Prague: 1907. Pp. 44.

903. Zeiner-Henriksen, K. (Growth of School Children.) *Nordsk. Mag. f. Laegevidensk.*, 1918, (79), 52-60. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 742.
This gives averages for 1333 boys and girls seven to 14 years, measured in the Horton, Norway, schools.

904. Zeiner-Henriksen, K. (The Growth of School Children) Part II. *Nordsk. Mag. f. Laegevidensk.*, 1920, (81), 262-271.
A report of increments in height between February and September 1916 for boys and girls at the ages seven to 14. Four tables and two graphs show the percentile distribution of gains in height, standard deviation and variation coefficient. The usual pubertal difference in the growth of the sexes is noted.

905. Zeising, A. *Neue Lehre von den Proportionen des menschlichen Körpers.* Leipzig: 1854.

906. Zeising, A. Über die Metamorphozen in den Verhältnissen der Menschlichen Gestalt von der Geburt bis zur Vollendung des Längenwachstums. *Verhandl. der Kais. Leop.-Car. Akad. d. Naturforscher*, 1858, (18), Part 2, 783.
This article supports the thesis that all the proportions of the body are related to each other in the ratio of the golden mean, and that given a few measurements, all the others can be derived by the use of this ratio. Some actual measurements are published for 10 individuals, for each age from one year to adult.

907. Zeising, A. *Die Metamorphosen in den Verhältnissen der menschlichen Gestalt*, & c. Bonn: 1859.

It is pointed out in this article that growth does not consist merely in a simple increase of the various dimensions, but in a continuous change of the relations between parts of the body always approximating the golden section.

908. ZEISING, A. Über die Metamorphosen in den Verhältnissen der menschlichen Gestalt von der Geburt bis zur Vollendung des Längenwachstums. *Abhandl. d. Bonner Acad.*, (26).

*909. ZELTNER, E. Die Beziehung zwischen Brustwachstum, Schädelwachstum und Körpergewichtzunahme bei Säuglinge. *Jahrb. f. Kinderheilk.*, 1911, (24), 421-428.

This presents individual curves of 64 infants, some normal, some in various pathological conditions, for the three measurements listed. A few of the curves extend for over a year. The three measurements are found to bear a constant relation to each other, the parallel course of development of chest circumference and weight being especially noticeable.

910. ZHBANKOFF,— (The Influence of the Common School on the Physical Development of Pupils.) *Vestnik obsh. hig. sudeb. i. prakt. med.*, 1889, (1), 147-194.

Russian, cited by Sack. See also *Messenger for Legal Medicine*, 1889, (3).

911. ZIRKLE, H. W. Interdependence of the Mental and Physical. In ZIRKLE: *Medical Inspection of Schools.* (University of Colorado Bulletin), 1902, (1), 3-23.

Contains many statistical tables from other authors, including Bowditch, Warner, Christopher, and others, with suggestions for measuring and an anthropological chart.

PART VII

CHAPTER XII

ENGLISH EQUIVALENTS FOR METRIC UNITS

1. TABLE—CENTIMETERS TO INCHES

Centi-meters	Inches	Centi-meters	Inches	Centi-meters	Inches	Centi-meters	Inches
1	.39	46	18.11	91	35.83	136	53.54
2	.79	47	18.50	92	36.22	137	53.94
3	1.18	48	18.90	93	36.61	138	54.33
4	1.57	49	19.29	94	37.01	139	54.72
5	1.97	50	19.69	95	37.40	140	55.12
6	2.36	51	20.08	96	37.80	141	55.51
7	2.76	52	20.47	97	38.19	142	55.91
8	3.15	53	20.87	98	38.58	143	56.30
9	3.54	54	21.26	99	38.98	144	56.69
10	3.94	55	21.65	100	39.37	145	57.09
11	4.33	56	22.05	101	39.76	146	57.48
12	4.72	57	22.44	102	40.16	147	57.87
13	5.12	58	22.83	103	40.55	148	58.27
14	5.51	59	23.23	104	40.94	149	58.66
15	5.91	60	23.62	105	41.34	150	59.06
16	6.30	61	24.02	106	41.73	151	59.45
17	6.69	62	24.41	107	42.13	152	59.84
18	7.09	63	24.80	108	42.52	153	60.24
19	7.48	64	25.20	109	42.91	154	60.63
20	7.87	65	25.59	110	43.31	155	61.02
21	8.27	66	25.98	111	43.70	156	61.42
22	8.66	67	26.38	112	44.09	157	61.81
23	9.06	68	26.77	113	44.49	158	62.20
24	9.45	69	27.17	114	44.88	159	62.60
25	9.84	70	27.56	115	45.28	160	62.99
26	10.24	71	27.95	116	45.67	161	63.39
27	10.63	72	28.35	117	46.06	162	63.78
28	11.02	73	28.74	118	46.46	163	64.17
29	11.42	74	29.13	119	46.85	164	64.57
30	11.81	75	29.53	120	47.24	165	64.96
31	12.20	76	29.92	121	47.64	166	65.35
32	12.60	77	30.32	122	48.03	167	65.75
33	12.99	78	30.71	123	48.43	168	66.14
34	13,39	79	31.10	124	48.82	169	66.54
35	13.78	80	31.50	125	49.21	170	66.93
36	14.17	81	31.89	126	49.61	171	67.32
37	14.57	82	32.28	127	50.00	172	67.72
38	14.96	83	32.68	128	50.39	173	68.11
39	15.35	84	33.07	129	50.79	174	68.50
40	15.75	85	33.46	130	51.18	175	68.90
41	16.14	86	33.86	131	51.57	176	69.29
42	16.54	87	34.25	132	51.97	177	69.69
43	16.93	88	34.65	133	52.36	178	70.08
44	17.32	89	35.04	134	52.76	179	70.47
45	17.72	90	35.43	135	53.15	180	70.87

2. TABLE—KILOGRAMS TO POUNDS

Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds
1	2.20	21	46.30	41	90.39	61	134.48
2	4.41	22	48.50	42	92.59	62	136.69
3	6.61	23	50.71	43	94.80	63	138.89
4	8.82	24	52.91	44	97.00	64	141.09
5	11.02	25	55.12	45	99.21	65	143.30
6	13.23	26	57.32	46	101.41	66	145.50
7	15.43	27	59.52	47	103.62	67	147.71
8	17.64	28	61.73	48	105.82	68	149.91
9	19.84	29	63.93	49	108.03	69	152.12
10	22.05	30	66.14	50	110.23	70	154.32
11	24.25	31	68.34	51	112.44	71	156.53
12	26.46	32	70.55	52	114.64	72	158.73
13	28.66	33	72.75	53	116.84	73	160.94
14	30.86	34	74.96	54	119.05	74	163.14
15	33.07	35	77.16	55	121.25	75	165.35
16	35.27	36	79.37	56	123.46	76	167.55
17	37.48	37	81.57	57	125.66	77	169.75
18	39.68	38	83.78	58	127.87	78	171.96
19	41.89	39	85.98	59	130.07	79	174.16
20	44.09	40	88.18	60	132.28	80	176.37

3. TABLE—DECILITERS TO CUBIC INCHES

Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches
.01	.06	.26	1.59	.51	3.11	.76	4.64
.02	.12	.27	1.65	.52	3.17	.77	4.70
.03	.18	.28	1.71	.53	3.23	.78	4.76
.04	.24	.29	1.77	.54	3.30	.79	4.82
.05	.31	.30	1.83	.55	3.36	.80	4.88
.06	.37	.31	1.89	.56	3.42	.81	4.94
.07	.43	.32	1.95	.57	3.48	.82	5.00
.08	.49	.33	2.01	.58	3.54	.83	5.06
.09	.55	.34	2.07	.59	3.60	.84	5.13
.10	.61	.35	2.14	.60	3.66	.85	5.19
.11	.67	.36	2.20	.61	3.72	.86	5.25
.12	.73	.37	2.26	.62	3.78	.87	5.31
.13	.79	.38	2.32	.63	3.84	.88	5.37
.14	.85	.39	2.38	.64	3.91	.89	5.43
.15	.92	.40	2.44	.65	3.97	.90	5.49
.16	.98	.41	2.50	.66	4.03	.91	5.55
.17	1.04	.42	2.56	.67	4.09	.92	5.61
.18	1.10	.43	2.62	.68	4.15	.93	5.68
.19	1.16	.44	2.68	.69	4.21	.94	5.74
.20	1.22	.45	2.75	.70	4.27	.95	5.80
.21	1.28	.46	2.81	.71	4.33	.96	5.86
.22	1.34	.47	2.87	.72	4.39	.97	5.92
.23	1.40	.48	2.93	.73	4.45	.98	5.98
.24	1.46	.49	2.99	.74	4.52	.99	6.04
.25	1.53	.50	3.05	.75	4.58	1.00	6.10
1	6.10	11	67.12	21	128.15	31	189.17
2	12.20	12	73.23	22	134.25	32	195.27
3	18.31	13	79.33	23	140.35	33	201.37
4	24.41	14	85.43	24	146.45	34	207.47
5	30.51	15	91.53	25	152.56	35	213.58
6	36.61	16	97.64	26	158.66	36	219.68
7	42.72	17	103.74	27	164.76	37	225.78
8	48.82	18	109.84	28	170.86	38	231.88
9	54.92	19	115.94	29	176.96	39	237.99
10	61.02	20	122.04	30	183.07	40	244.09

4. TABLE—INCHES TO CENTIMETERS

Inches	Centi-meters	Inches	Centi-meters	Inches	Centi-meters	Inches	Centi-meters
.01	.03	.26	.66	.51	1.30	.76	1.93
.02	.05	.27	.69	.52	1.32	.77	1.96
.03	.08	.28	.71	.53	1.35	.78	1.98
.04	.10	.29	.74	.54	1.37	.79	2.01
.05	.13	.30	.76	.55	1.40	.80	2.03
.06	.15	.31	.79	.56	1.42	.81	2.06
.07	.18	.32	.81	.57	1.45	.82	2.08
.08	.20	.33	.84	.58	1.47	.83	2.11
.09	.23	.34	.86	.59	1.50	.84	2.13
.10	.25	.35	.89	.60	1.52	.85	2.16
.11	.28	.36	.91	.61	1.55	.86	2.18
.12	.31	.37	.94	.62	1.57	.87	2.21
.13	.33	.38	.97	.63	1.60	.88	2.24
.14	.36	.39	.99	.64	1.63	.89	2.26
.15	.38	.40	1.02	.65	1.65	.90	2.29
.16	.41	.41	1.04	.66	1.68	.91	2.31
.17	.43	.42	1.07	.67	1.70	.92	2.34
.18	.46	.43	1.09	.68	1.73	.93	2.36
.19	.48	.44	1.12	.69	1.75	.94	2.39
.20	.51	.45	1.14	.70	1.78	.95	2.41
.21	.53	.46	1.17	.71	1.80	.96	2.44
.22	.56	.47	1.19	.72	1.83	.97	2.46
.23	.58	.48	1.22	.73	1.85	.98	2.49
.24	.61	.49	1.24	.74	1.88	.99	2.52
.25	.64	.50	1.27	.75	1.91	1.00	2.54
17	43.18	32	81.28	47	119.38	62	157.48
18	45.72	33	83.82	48	121.92	63	160.02
19	48.26	34	86.36	49	124.46	64	162.56
20	50.80	35	88.90	50	127.00	65	165.10
21	53.34	36	91.44	51	129.54	66	167.64
22	55.88	37	93.98	52	132.08	67	170.18
23	58.42	38	96.52	53	134.62	68	172.72
24	60.96	39	99.06	54	137.16	69	175.26
25	63.50	40	101.60	55	139.70	70	177.80
26	66.04	41	104.14	56	142.24	71	180.34
27	68.58	42	106.68	57	144.78	72	182.88
28	71.12	43	109.22	58	147.32	73	185.42
29	73.66	44	111.76	59	149.86	74	187.96
30	76.20	45	114.30	60	152.40	75	190.50
31	78.74	46	116.84	61	154.94	76	193.04

5. TABLE—SQUARE INCHES TO SQUARE MILLIMETERS

Square Inches	Square Milli-meters	Square Inches	Square Milli-meters	Square Inches	Square Milli-meters	Square Inches	Square Milli-meters
.01	6.45	.26	167.74	.51	329.03	.76	490.32
.02	12.90	.27	174.19	.52	335.48	.77	496.77
.03	19.35	.28	180.64	.53	341.93	.78	503.22
.04	25.81	.29	187.10	.54	348.39	.79	509.68
.05	32.26	.30	193.55	.55	354.84	.80	516.13
.06	38.71	.31	200.00	.56	361.29	.81	522.58
.07	45.16	.32	206.45	.57	367.74	.82	529.03
.08	51.61	.33	212.90	.58	374.19	.83	535.48
.09	58.06	.34	219.35	.59	380.64	.84	541.93
.10	64.52	.35	225.81	.60	387.10	.85	548.39
.11	70.97	.36	232.26	.61	393.55	.86	554.84
.12	77.42	.37	238.71	.62	400.00	.87	561.29
.13	83.87	.38	245.16	.63	406.45	.88	567.74
.14	90.32	.39	251.61	.64	412.90	.89	574.19
.15	96.77	.40	258.06	.65	419.35	.90	580.64
.16	103.23	.41	264.52	.66	425.81	.91	587.10
.17	109.68	.42	270.97	.67	432.26	.92	593.55
.18	116.13	.43	277.42	.68	438.71	.93	600.00
.19	122.58	.44	283.87	.69	445.16	.94	606.45
.20	129.03	.45	290.32	.70	451.61	.95	612.90
.21	135.48	.46	296.77	.71	458.06	.96	619.35
.22	141.94	.47	303.23	.72	464.52	.97	625.81
.23	148.39	.48	309.68	.73	470.97	.98	632.26
.24	154.84	.49	316.13	.74	477.42	.99	638.71
.25	161.29	.50	322.58	.75	483.87	1.00	645.16

6. TABLE—CUBIC INCHES TO DECILITERS

Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters
1	.16	51	8.36	101	16.55	151	24.75	201	32.94
2	.33	52	8.52	102	16.72	152	24.91	202	33.10
3	.50	53	8.69	103	16.88	153	25.07	203	33.27
4	.66	54	8.85	104	17.04	154	25.24	204	33.43
5	.82	55	9.01	105	17.21	155	25.40	205	33.59
6	.98	56	9.18	106	17.37	156	25.57	206	33.76
7	1.15	57	9.34	107	17.54	157	25.73	207	33.92
8	1.31	58	9.51	108	17.70	158	25.89	208	34.09
9	1.48	59	9.67	109	17.86	159	26.06	209	34.25
10	1.64	60	9.83	110	18.03	160	26.22	210	34.41
11	1.80	61	10.00	111	18.19	161	26.38	211	34.58
12	1.97	62	10.16	112	18.35	162	26.55	212	34.74
13	2.13	63	10.32	113	18.52	163	26.71	213	34.91
14	2.29	64	10.49	114	18.68	164	26.88	214	35.07
15	2.46	65	10.65	115	18.85	165	27.04	215	35.23
16	2.62	66	10.82	116	19.01	166	27.20	216	35.40
17	2.79	67	10.98	117	19.17	167	27.37	217	35.56
18	2.95	68	11.14	118	19.34	168	27.53	218	35.73
19	3.11	69	11.31	119	19.50	169	27.70	219	35.89
20	3.28	70	11.47	120	19.67	170	27.86	220	36.05
21	3.44	71	11.64	121	19.83	171	28.02	221	36.22
22	3.61	72	11.80	122	19.99	172	28.19	222	36.38
23	3.77	73	11.96	123	20.16	173	28.35	223	36.54
24	3.93	74	12.13	124	20.32	174	28.51	224	36.71
25	4.10	75	12.29	125	20.48	175	28.68	225	36.87
26	4.26	76	12.46	126	20.65	176	28.84	226	37.04
27	4.43	77	12.62	127	20.81	177	29.01	227	37.20
28	4.59	78	12.78	128	20.98	178	29.17	228	37.36
29	4.75	79	12.95	129	21.14	179	29.33	229	37.53
30	4.92	80	13.11	130	21.30	180	29.50	230	37.69
31	5.08	81	13.27	131	21.47	181	29.66	231	37.86
32	5.24	82	13.44	132	21.63	182	29.83	232	38.02
33	5.41	83	13.60	133	21.80	183	29.99	233	38.18
34	5.57	84	13.77	134	21.96	184	30.15	234	38.35
35	5.74	85	13.93	135	22.12	185	30.32	235	38.51
36	5.90	86	14.09	136	22.29	186	30.48	236	38.68
37	6.06	87	14.26	137	22.45	187	30.65	237	38.84
38	6.28	88	14.42	138	22.62	188	30.81	238	39.00
39	6.39	89	14.59	139	22.78	189	30.97	239	39.17
40	6.56	90	14.75	140	22.94	190	31.14	240	39.33
41	6.72	91	14.91	141	23.11	191	31.30	241	39.49
42	6.84	92	15.08	142	23.27	192	31.46	242	39.66
43	7.05	93	15.24	143	23.43	193	31.63	243	39.82
44	7.21	94	15.40	144	23.60	194	31.79	244	39.99
45	7.37	95	15.57	145	23.76	195	31.96	245	40.15
46	7.54	96	15.73	146	23.93	196	32.12	246	40.31
47	7.70	97	15.90	147	24.09	197	32.28	247	40.48
48	7.87	98	16.06	148	24.25	198	32.45	248	40.64
49	8.03	99	16.22	149	24.42	199	32.61	249	40.81
50	8.19	100	16.39	150	24.58	200	32.78	250	40.97

7. TABLE—POUNDS TO KILOGRAMS

Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams
.1	.05	.4	.18	.7	.32	1.0	.45
.2	.09	.5	.23	.8	.36		
.3	.14	.6	.27	.9	.41		
5	2.27	50	22.68	95	43.09	140	63.50
6	2.72	51	23.13	96	43.54	141	63.96
7	3.18	52	23.59	97	44.00	142	64.41
8	3.63	53	24.04	98	44.45	143	64.86
9	4.08	54	24.49	99	44.91	144	65.32
10	4.54	55	24.95	100	45.36	145	65.77
11	4.99	56	25.40	101	45.81	146	66.22
12	5.44	57	25.85	102	46.27	147	66.68
13	5.90	58	26.31	103	46.72	148	67 13
14	6.35	59	26.76	104	47.17	149	67.58
15	6.80	60	27.22	105	47.63	150	68.04
16	7.26	61	27.67	106	48.08	151	68.49
17	7.71	62	28.12	107	48.53	152	68.95
18	8.17	63	28.58	108	48.99	153	69.40
19	8.62	64	29.03	109	49.44	154	69.85
20	9.07	65	29.48	110	49.89	155	70.31
21	9.53	66	29.94	111	50.35	156	70.76
22	9.98	67	30.39	112	50.80	157	71.21
23	10.43	68	30.84	113	51.26	158	71.67
24	10.89	69	31.30	114	51.71	159	72.12
25	11.34	70	31.75	115	52.16	160	72.57
26	11.79	71	32.20	116	52.62	161	73.03
27	12.25	72	32.66	117	53.07	162	73.48
28	12.70	73	33.11	118	53.52	163	73.94
29	13.15	74	33.57	119	53.98	164	74.39
30	13.61	75	34.02	120	54.43	165	74.84
31	14.06	76	34.47	121	54.88	166	75.30
32	14.51	77	34.93	122	55.34	167	75.75
33	14.97	78	35.38	123	55.79	168	76.20
34	15.42	79	35.83	124	56.25	169	76.66
35	15.88	80	36.29	125	56.70	170	77.11
36	16.33	81	36.74	126	57.15	171	77.56
37	16.78	82	37.19	127	57.61	172	78.02
38	17.24	83	37.65	128	58.06	173	78.47
39	17.69	84	38.10	129	58.51	174	78.92
40	18.14	85	38.56	130	58.97	175	79.38
41	18.60	86	39.01	131	59.42	176	79.83
42	19.05	87	39.46	132	59.87	177	80.29
43	19.50	88	39.92	133	60.33	178	80.74
44	19.96	89	40.37	134	60.78	179	81.19
45	20.41	90	40.82	135	61.23	180	81.65
46	20.87	91	41.28	136	61.69	181	82.10
47	21.32	92	41.73	137	62.14	182	82.55
48	21.77	93	42.18	138	62.60	183	83.01
49	22.23	94	42.64	139	63.05	184	83.46

A PRACTICAL SCORE CARD

TO DETERMINE THE NORMAL GROWTH OF CHILDREN (English Units of Measure)

Average Weight in Pounds	1½ mos.	4½ mos.	7½ mos.	10½ mos.	13½ mos.	16½ mos.	19½ mos.	24 mos.	2½ yrs.	3 yrs.	3½ yrs.	4 yrs.	4½ yrs.	5 yrs.
Boys:	11.4	15.6	18.4	20.1	21.6	23.0	24.5	26.0	28.3	30.5	32.6	34.6	35.8	37.6
Girls:	10.2	14.5	17.6	19.0	20.2	21.3	23.3	24.9	27.1	29.1	31.1	32.7	34.2	36.3
Average Height in Inches														
Boys:	22.8	25.5	27.3	28.6	29.9	31.1	32.3	33.6	35.0	36.7	38.2	39.4	40.5	41.8
Girls:	22.1	24.9	27.0	28.1	29.2	30.4	31.8	33.0	34.7	36.2	37.7	39.0	40.1	41.4
Weight-Height Index $= \frac{\text{Height}}{\text{Weight}}$														
Boys: Maximum Index 15% above av. normal	.58	.70	.77	.81	.83	.84	.87	.89	.93	.95	.98	1.01	1.01	1.04
Average Normal Index	.50	.61	.67	.70	.72	.73	.76	.77	.81	.83	.85	.88	.88	.90
Minimum Index 15% below av. normal	.42	.52	.57	.59	.61	.62	.65	.65	.69	.71	.72	.75	.75	.76
Girls: Maximum Index 15% above av. normal	.53	.67	.75	.77	.79	.81	.84	.86	.90	.92	.94	.97	.98	1.01
Average Normal Index	.46	.58	.65	.67	.69	.70	.73	.75	.78	.80	.82	.84	.85	.88
Minimum Index 15% below av. normal	.39	.49	.55	.57	.59	.59	.62	.64	.66	.68	.70	.71	.72	.75
Gain in Weight in Ounces per month	Birth–1½ m	1½–4½ mos.	4½–7½ mos.	7½–10½ mos.	10½–13½ m	13½–16½ m	16½–19½ m	19½–24 m	24m–2½ yr.	2½–3 yrs.	3–3½ yrs.	3½–4 yrs.	4–4½ yrs.	4½–5 yrs.
Boys: Maximum Gain	38	28	19	11	10	9	10	6	8	8	8	6	4	6
Average Normal Gain	30	22	15	9	8	7	8	5	6	6	6	5	3	5
Minimum Gain	22	16	11	7	6	5	6	4	4	4	4	4	2	4
Girls: Maximum Gain	35	29	21	9	8	8	14	8	8	6	6	5	5	8
Average Normal Gain	28	23	17	7	6	6	11	6	6	5	5	4	4	6
Minimum Gain	21	17	13	5	4	4	8	4	4	4	4	3	3	4

A PRACTICAL SCORE CARD (Continued)

	5½ yrs.	6 yrs.	7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
Average Weight in Pounds													
Boys:	39.6	45.2	50.6	55.3	60.7	67.2	73.1	77.7	88.4	98.3	109.4	120.6	128.2
Girls:	38.1	42.6	48.0	53.8	59.7	67.2	74.1	83.9	96.2	107.2	115.5	120.6	121.8
Average Height in Inches													
Boys:	43.0	45.4	47.8	49.8	51.5	53.5	55.3	56.9	59.3	61.8	64.1	66.7	67.6
Girls:	42.2	44.3	46.8	49.1	51.1	53.1	55.3	57.6	60.1	61.8	62.7	63.6	63.6
Weight-Height Index $= \frac{\text{Weight}}{\text{Height}}$													
Boys: Maximum Index 15% above av. normal	1.06	1.14	1.21	1.28	1.35	1.44	1.52	1.56	1.71	1.83	1.96	2.07	2.17
Average Normal Index	.92	.99	1.05	1.11	1.17	1.25	1.32	1.36	1.49	1.59	1.70	1.80	1.89
Minimum Index 15% below av. normal	.78	.84	.89	.94	.99	1.06	1.12	1.16	1.27	1.35	1.44	1.53	1.61
Girls: Maximum Index 15% above av. normal	1.04	1.10	1.17	1.25	1.33	1.45	1.53	1.67	1.84	1.99	2.12	2.17	2.20
Average Normal Index	.90	.96	1.02	1.09	1.16	1.26	1.33	1.45	1.60	1.73	1.84	1.89	1.91
Minimum Index 15% below av. normal	.76	.82	.87	.93	.99	1.07	1.13	1.23	1.36	1.47	1.56	1.61	1.62
Gain in Weight in Ounces per month	5–5½ yrs.	5½–6 yrs.	6–7 yrs.	7–8 yrs.	8–9 yrs.	9–10 yrs.	10–11 yrs.	11–12 yrs.	12–13 yrs.	13–14 yrs.	14–15 yrs.	15–16 yrs.	16–17 yrs.
Boys: Maximum Gain	6	9	9	8	9	11	10	8	18	16	19	19	13
Average Normal Gain	5	7	7	6	7	9	8	6	14	13	15	15	10
Minimum Gain	4	5	5	4	5	7	6	4	10	10	11	11	7
Girls: Maximum Gain	6	8	9	10	10	13	11	16	20	19	14	9	3
Average Normal Gain	5	6	7	8	8	10	9	13	16	15	11	7	2
Minimum Gain	4	4	5	6	6	7	7	10	12	11	8	5	1

Data gathered by Federal Children's Bureau and Iowa Child Welfare Research Station.

Data selected from 18,770 Iowa boys and 18,188 Iowa girls from 1½ months to six years of age.

From six years to 17 years inclusive the measurements are from Horace Mann School on an average of 125 boys and 125 girls semi-annually for periods of eight years or more (10,000 measurements). All children were nude. No measurements were more than three months from exact age.

For children under 24 months to six years, two pounds; from six to 10 years, 2½ pounds; from 10 years to 12 years, three pounds; and from 12 to 17 years, 3¾ pounds.

A well developed tall or short child should approach within 15% of the weight-height index for the chropological age to which the child's height corresponds.